THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE METRIC SYSTEM AND DECIMAL COINAGE: SHALL WE ADOPT THEM?

IT is universally recognised that the vast upheaval which is shaking the foundations of civilisation and engrossing the attention of all humanity will not pass away and leave things as they were. We shall find ourselves in a changed world, faced with new conditions, and with a very different outlook upon our surroundings; neither business nor pleasure will be "as usual"—we shall have to adapt ourselves to conform with the new *régime*, and to bring ourselves into harmony with our environment as closely as possible. "Efficiency" in all respects must be our watchword—efficiency in organisation, in production, in distribution—and in order to attain efficiency every obstacle to our industrial and commercial progress must be removed, gently if possible, but firmly in any event. We are only gradually learning the lesson; our rulers have not yet dared to call upon us as a nation to make the supreme sacrifice and to attain the highest ideal of patriotism by subordinating ourselves and our private aims and feelings absolutely to the imperative needs of our country—but the time is fast approaching when they will do so. It is an epoch in the history of our race—we trust, a triumphant epoch; only those who merit victory can command it, and we confidently believe that the nation will prove itself worthy, as it has done before, and will shoulder the burden cheerfully and with unflinching determination to conquer.

But it is not only in the ranks of the Army and Navy, or of the makers of munitions of war, that self-sacrifice must be manifested; in every part of our social, domestic, and political life the welfare of the nation must be the predominant consideration, before which all private interests must give way. We are a conservative people—but we must learn to be progressive, bearing in mind that any hindrance to our progress must be ruthlessly flung aside. And surely there is no greater obstacle to our commercial welfare than the obsolete systems—if such they can be called—of coinage, weights, and measures that handicap our intercourse with foreign nations and impede the development of our trade, to an extent that is fully realised by few. We have for many years advocated reform in this connection, and we believe that the return of peace will afford an ideal and unique opportunity to bring it about—an opportunity such as may never recur.

In normal times, a great objection to the adoption of new weights and measures has been the "dislocation of trade" that many feared would ensue; now that our export trade has undergone a compound fracture, surely no one will hint at dislocation. The mind of the country is aroused; men and women in all ranks of society are alert, they are in a mood to receive new ideas, and to consider them without that tendency to prejudice with which we are afflicted in

time of peace. Now, then, is the time; and we earnestly call upon all advocates of efficiency and reform to aid us in our efforts to convince the opponents of change that it is their duty to accept new systems of weights, measures, and coinage, for the sake of their country's welfare.

During the past month we have been preparing to open a campaign for this purpose, with the results which are set forth elsewhere in this issue; the prospects are far more favourable than we had dared to hope, and we are encouraged to believe that at least one great blessing may perhaps be gathered from this otherwise accursed conflict of the nations—the reform of our units.

While our inquiry made no pretence of being exhaustive, it was addressed to very diversified classes of firms, and the answers appear to be derived from all parts of the field embraced; they may therefore be taken to represent the opinions of a fair sample of the British manufacturers belonging to, or connected with, the electrical industries, and this view is strengthened by the fact that the proportion of ayes to noes has remained roughly constant from the time when they began to come in. Many of the replies were accompanied by interesting letters, a selection from which will be published in due course.

We may observe that, while we have here coupled the metric system and decimal coinage under one heading, we do not suggest that they are necessarily combined or interdependent; either could be adopted without the other, and it is interesting to note that although the numbers respectively for and against these two items are approximately equal, many of our correspondents favour one whilst objecting to the other. In view of the necessity of economising clerical labour after the war, we are disposed to regard the adoption of decimal coinage as of importance second only to that of the metric system. No one who has lived abroad for any length of time will dispute the assertion that facility in dealing with decimal coinage is acquired in a very few days, and that the simplicity of the system endows it with immense advantages over our awkward sub-divisions, rendering many calculations almost automatic. Similarly, it is to those who have had extended experience of the use of metric weights and measures that we should turn for guidance; and their verdict is unanimous. Most of the opposition to both systems is, we believe, founded upon lack of acquaintance with their true merits, and upon erroneous ideas regarding the difficulty of adopting them in office and workshop; we shall endeavour to convince the sceptics, asking them in the meantime to preserve an open mind, and to weigh judicially the pros and cons.

Copper.

The copper market has maintained a pretty uniform appearance of firmness, and it has become increasingly evident during the past few weeks that producers in America are in a position in which they can practically enforce their own terms. The fact that the financial centre of the world has, as one of the results of the war, practically left this country and settled itself in New York, is bound to play a more and more important part in the furtherance and extension of speculative operations across the Atlantic in all directions where the abundant supply of capital becomes a necessary accessory. So long as London regulated the world's money market, so long were American speculative interests, which were dependent upon the money market for carrying out their plans, continually thwarted, besides having their plans of campaign rendered the more difficult to arrange owing to the necessity of taking the London money market into their calculations. All this is now a thing of the past, and America, by drawing gold by the tens of millions from Europe, has assumed a financial superiority which her most enthusiastic financiers never foresaw. America can now finance copper by the hundred thousand tons if she chooses to do so, without any undue anxiety regarding the immediate consequences, and the outlook for the copper market has, therefore, undergone a fundamental alteration with the recognition of this fact by leading producers across the Atlantic. There is no longer any pretence made that consumption is absorbing output. Leading American smelters and refiners, indeed, state that they are accumulating stocks at their refineries, but they add that financial conditions are so altered that they can easily afford to pursue a policy which, but for the war, would have landed them inevitably, and in a short time, in an uncomfortable situation. Trade buying is pretty good, but naturally enough falls far below that of normal times, if only for the reason that Central Europe is cut off from the rest of the world. There is not much speculative interest taken in the London market; indeed, there is no money in this country available for speculation, and there will be less and less as the drain of capital proceeds without cessation. The Americans may continue to accumulate copper until the end of the war (whenever this may be), but if they are going to finance a tonnage increase at the present rate from now until then, there seems under the present somewhat disconsolate surroundings the chance of sufficient copper being piled up across the Atlantic to supply the entire world's requirements for many months *ex* stock. It is useless to attempt to forecast the future under the topsy-turvy conditions prevailing to-day; but for the time being entire control of the situation seems to be vested in producers.

The Appeal from the Trenches for More Munitions.

A report prepared by another party of munition workers who have been to the Front, makes an urgent appeal on behalf of the Forces for more shells, more high-explosive shells, more galvanised iron to make roofs for the trenches, more expanded metal to hold up the sides, and more cable for communications. The men called for more of this, and more of that, but the deputation also saw the need as well as heard it expressed, and they appeal to everyone without exception, to give their best efforts and maintain such a record that the results will sustain all wants at the Front. The report, which is signed by representatives of the Steam Engine Makers' Society, United Brass Founders' Society, the Amalgamated Society of Engineers, the Electrical Trades' Union, and the Boiler-makers' Iron and Steel Shipbuilders' Society, says among other things:—"Industrial stoppages, for no matter what motive, cause great indignation. Our troops feel that, while they toil and fight under the full stress of modern military conditions, it is wicked and wrong for anyone to impede their supplies. Every course of action, whether by employers or men, that results in a limited output is regarded with the same detestation." Further: "Nothing more inspiring than the sight of our men at the Front can be imagined, and we return from our tour with a single desire—to do all in our power to maintain and increase the supplies on which the success of their heroic endeavours depends, and without which all they have been giving, and must still give, will have been given in vain."

We trust that such words as these, telling such terrible truths, will burn their way into the minds and hearts of all who have in hand any work whatsoever, the expediting of which may help to back up those who are fighting for, or with us, on so many Fronts. Such testimonies should not be merely printed once in the morning newspapers, to be overlooked among the other important matters of the day, or circulated in a "report to members," to be put out of sight after once perusing; they should be used as effective posters, printed in big type and placed on hoardings wherever vital manufacturing operations are proceeding, and in the thousand munitions factories too.

THE ELECTRICAL INDUSTRY IN THE UNITED STATES.

By "CONTANGO."

[This article contains a general view of present conditions, with some specific facts of interest to the manufacturer and central station manager alike. The author is a well-known financial writer of Chicago and New York, who also specialises on electrical matters, and who has just come safely through the War Zone.]

It is generally said in the United States that advertising bills are always the last to be paid, be it by manufacturing concerns or by big corporations. Whether this is the case in England, and why it is so in the United States, one does not know. But one does know that when times are bad and business is poor, in nine cases out of ten the advertising appropriation is the first to be cut, and also that the only man who does good business at such a time, and progresses in spite of depression, and the "cut expense at any cost" policy of his fellows, is the odd man who persists in sticking to it with his advertising. It is unusual, because, of course, he is the unusual man. This being the case, and it certainly is so in the States, in the opinion of one who derives his opinions from 25 years of observation, it may be stated that one and all of the great American corporations, industrial and public utility, started this year with a substantial cut in their annual appropriation for advertising. Let me give a succinct example of what this means. One of the great Chicago public utility companies has been accustomed for several years past to spend $260,000 a year on advertising put out by its advertising department, not to mention considerable in addition authorised by the executive department; but in January this year, when considering the Budget with a view to the future, it cut that figure by just about $50,000. Has the business of 1915 so far justified this, and was the economy a wise one? To the first question the answer must be "Yes"; to the second as a general proposition, the answer must be "No," and, in this particular instance, also "No," because there has been a betterment in the autumn outlook in the States for the first time since 1912. Therefore, continuous advertising would have been better.

Literally, as far as the electrical industry is concerned, there has been poor business, with a rather poor outlook since the middle of 1913 up to August of this year. Even the most determined boosters have allowed this "on the quiet," if not in public. The year 1913 closed with the tide decidedly at the ebb and business very dull. Then the beginning of 1915 showed a very slight turn with, however, a considerably larger volume of business than at any time in 1914. Though the American exports showed a big jump towards the closed of 1914, the electrical industry was not responsible as yet for much of this. Provisions and grain and the steel companies had the lion's share. However, there are very many manufacturing concerns identified with the electrical and kindred industries rushed at this time with war orders. To what extent this benefits the industry as a whole is a moot question; in ordinary times there would have been extreme difficulty in filling normal demands of central station systems and of electrical plants in all parts of the country, also the dealer in electrical supplies would have been hard put to it to get any orders through, but until just recently the central station systems and other electrical plants, as well as the dealer, had not been in the market to any extent; moreover, it must be noted here that while an increase in the use of electric power is steadily maintained by a change from steam, or by installations in new factories, yet, owing to the shutting-down of activity in many industrial lines, this development has not gone ahead as fast as usual. The point to consider in a broad way is, assuming the war to last for a considerable time longer, to what extent will the United States become the workshop of the world? England is more and more taken up with war needs in all branches of trade, so for that matter is France, and so will be any nation engaged in the conflict. Germany doesn't count, because her ability to do anything outside of herself has been completely crippled. This, then, bears on the immediate future to the extent that no man can tell at all what will happen in regard to the expansion of the electrical industry from the manufacturer's point of view by reason of the electrical needs of other nations. As to the central station, capital has for two years been withheld from the development of this branch. Extensions, as well as new projects, have been held back. Combination and consolidation of plants into systems have remained dormant. The usual capital released would, therefore, bring about tremendous expansion. But the question is, where is the capital to come from? As a rule it has flowed not only from England but from other European countries, or at any rate to the extent that international finance has played a sufficient part in American affairs to set free home capital in large quantities, both for the manufacturing end of the industry and the development of new centres of generation. But there is no such international finance these days.

There are in all parts of the country hydro-electric developments which it was intended to put into operation long ago. In the big centres of population the increase in building and new additions is beginning to crowd the existing generating stations. It must never be forgotten that the population is always increasing, and in the United States the growth of cities is extraordinarily rapid. All this increase in growth calls for an ever-increasing electrical supply, and the increase in the use of current means corresponding increase in the manufacture of transformers, cables, everything connected with the transmission of "juice" in fact, and then comes the increase in the use of appliances, devices, lamps and electrical conveniences of every kind. In the United States everything is electrical.

In point of fact, the electrical supply men, and even manufacturers, have said "nothing doing," when asked how business has been, at any time during the past two years. The outlook, however, is rather different now, for there is pressure from within and from without. If investors will get over their timidity and let their money go to help supply, even a portion of that daily five million dollars which it is estimated is needed at this period by the electrical central station industry as a whole, then there will be a tremendous forward movement in the United States, the signs of which are already slightly indicated.

One thing good has happened from the forced economies of the last two years, and that is the large organisations have learnt exactly where there has been waste and where hidden extravagance has gone on unchecked. Many corporations offered prizes to their employés for suggestions as to where a saving might be effected. This brought out all manner of unsuspected leaks. To be specific, one corporation used to allow each of its departments to handle its own stamps practically just as the head of the department would instead of having a central mailing department. This has now been established, and the result is a very remarkable saving in the stamp appropriation. Specific details such as these are given to show how very thoroughly in the past two years there has been a house-cleaning with the American corporations and industrial concerns. In conclusion, it may be stated most emphatically that the electrical industry in the United States has weathered the past two years of stress better than any other section of the industrial world. As to the central station systems, they, too, have for the most part kept up their interest and dividends. The number of failures has been comparatively small, though, of course, to achieve these results they have had to reduce their force of employés very considerably in all sections of the country.

The outlook, then, is good, better than it has been for a couple of years, and it is quite possible that the future may be one of very extraordinary growth, at any rate so far as the manufacturer is concerned. The English reader now has the facts before him as to existing conditions in the States and can be so guided.

New Diesel Engine.—A new type of Diesel engine has just been completed at the works of Messrs. Franco Tosi, at Legnano. It is of 1,000 H.P., and is intended for electrical work at the Government docks at Taranto. The engine, which is stated to embody several improvements, is of the four-cylinder, two-cycle single-acting type.

ENGINEERING AND OTHER SOCIETIES: THE 1915-16 SESSION.

We have made inquiries of the secretaries of various engineering and other scientific societies and organisations with reference to arrangements for the session which is now beginning. While many familiar faces will be missing owing to the war, in only a few cases has it been found necessary to make any material alterations so far as the holding of meetings is concerned. Meetings of graduates and students would hardly be expected at such a time when men of eligible age are either with the Forces or engaged upon engineering munitions work. We give below the result of our inquiries :—

Institution of Electrical Engineers.—The Institution will hold its first London meeting for the session on Thursday, November 11th, when Mr. P. C. Sparks, the new president, will deliver his inaugural address. The London and provincial Sections will meet practically as usual, but it may happen that one or two of the Local Sections will slightly reduce the number of meetings. The number of members of all classes with the Forces is at present 1,100.

The arrangements for the first half of Session are as follows :—

November 11th.—Mr. C. P. Sparks's Presidential Address.
November 25th.—Prof. A. B. Field, "Difficulties of Design of High-Speed Generators."
December 9th.—Mr. J. R. Beard, "The Design of High-Pressure Distribution Systems."
January 13th, 1916.—Prof. Miles Walker, "The Predetermination of the Performance of Dynamo-Electric Machines."
January 27th.—Mr. N. W. Storer, "The Possibilities in the Design of D.C. Traction Motors, &c."

The Institution of Civil Engineers.—The sessional meetings of the Institution will be held fortnightly as last year. The papers submitted for discussion in the early part of the session will include several communications on the question of wave-action in harbours, and papers on "Economy in Turbines and Condensers," "The Punjab Triple Canal Project," "The Main Drainage of Cairo, and the Rangoon River-Training Works." Naturally, the meetings will be considerably affected by the war, and following the course adopted last year, it is not proposed to hold Students' Meetings. The secretary (Dr. J. H. T. Tudsbery) already has a note of the names of some 1,500 of the members and students of the Institution who are in naval and military service, and it is probable that a larger number is so occupied in transport and munition work of all kinds that, for the time being, their attention must be altogether withdrawn from participation in the work of professional societies.

Institution of Mechanical Engineers.—A list of dates of meetings has just been issued. The first meeting takes place to-night, as already announced. Approximately 610 members of all classes of the Institution are serving in the Army or Navy.

Association of Mining Electrical Engineers.—It is not at present contemplated that the usual arrangements for branch meetings during the forthcoming Session will be altered consequent upon the war. The branches make their own arrangements regarding their meetings. So far as has been ascertained, 79 members of the Association are serving with the Imperial Forces.

Institution of Mining Engineers.—The general and annual general meetings of this Institution will be held next year, as usual, but the dates have not yet been fixed. About 250 members are at present serving with his Majesty's Forces, and we regret to learn that 20 members have been killed in action.

Faraday Society.—No particular alterations are being made in arrangements for the forthcoming session. A meeting is to be held on Tuesday next as announced to-day in your "Forthcoming Events." The society will hold a general discussion on "The Corrosion of Metals," the date of which will, in all probability, be early in December. Further details with regard to this meeting will be available later. A register is in course of preparation of members serving at the Front or serving H.M. Government in other ways.

Junior Institution of Engineers.—The meetings will be held as usual; the monthly one on the second Monday in the month, and the weekly ones every Friday. Approximately 185 members have joined the Forces. The following arrangements are announced :—

Friday, October 22nd.—"Safety Precautions for Transmission Machinery," by Mr W. V. H. Capps.
Friday, October 29th.—"Electric Clocks," by Mr. W. B. Prince.

Association of Charge Engineers.—The Session opened on Wednesday last with the presidential address of Mr. Frank Bailey. It has been only with great difficulty that arrangements for the Session have been made. All the usual Socials have been dropped for the year, but a date has been provisionally fixed for the Annual Dinner "in the hope that we may have good cause for rejoicing." Many members have resigned previous positions and entered upon service in munitions factories; some are in the R.N.A.S., and others in other branches of the Forces. The following are some of the fixtures for the Session :—

December 8th.—Mr. A. E. Penn on "Ammunition Manufacture."
January 13th, 1916.—Mr. W. H. Booth on "Limit Gauges and their Applications."
February 9th.—Mr. Wilfrid Stokes on "Multiple Effect and Systems of Refrigeration."
March 8th.—Mr. W. H. Petty on "Lubricating Oils."
March 25th.—Annual Dinner.
April 12th.—Mr. Gerald Stoney on "Steam Turbines."

Society of Engineers (Inc.).—Meetings will be held as usual. No alteration was made last session, and the attendances at meetings were quite up to the average. The list of members with the Forces is very incomplete, containing the names of only 42 gentlemen.

North-East Coast Institution of Engineers and Shipbuilders.—No alterations are contemplated in the meeting arrangements for the Session, beyond that the meetings of the Graduate Section will be curtailed owing to the fact that a large number of Graduates are away on Active Service. The active Session of the Institution begins on Friday, the 29th inst., when Mr. Herbert Rowell, president elect, will deliver his presidential address. The following and other papers will be read on dates to be announced :—

"The Time Element in some Ship Calculations," by Prof. J. J. Welch.
"Notes on Ship Model Experiments," by Mr. G. S. Baker.
"The Education of Youths before and during their Apprenticeship," by Principal V. A. Mundella.
"The Organisation of Works," by Mr. P. B. Newell.
"The Standardisation of Stability Curves," by Mr. Wilfred Ayre.

So far as is known the number of members serving with the Forces is 150.

Manchester Association of Engineers.—The coming session will be on practically the same lines as those of previous years. The inaugural address of the President (Mr. Samuel Boswell) was delivered on Saturday last. Other items in the Syllabus are as follow :—

October 23rd.—Prof. J. E. Petavel (Manchester University), on "Notes on Some Recent Researches."
November 13th.—Mr. C. E. Stromeyer on "Science and Practice in Engineering."
November 27th.—Mr. H. J. Moysey on "Design and Application of Ball Bearings."
December 18th.—Topical Discussion Evening.
January 8th, 1916.—Mr. Alfred Etchells on "The Importance of Uniform Conditions for Engineering Operations and Industrial Work."
January 22nd.—Mr. E. L. Rhead on "Cast-Iron: The Strength and Properties of Castings."
February 12th.—Mr. G. E. Windeler on "Oil Engines."
February 26th.—Mr. Ernest F. Lange on "Cast Steel as a Material of Construction."
March 11th.—Mr. James Tinto on "India-Rubber and Balata Belting as Conveyor and Power Transmission Belts."
March 25th.—Report of the Tool Steel Research Committee.

Post Office, Telephone and Telegraph Society of London.—The membership of this Society is open to both sexes. About 50 male members have joined the Forces. The Society was reorganised on its present basis for the 1913-14 session, and the membership would have increased but for the war, which depleted the staff eligible for membership and caused additional demands upon those remaining behind. The following arrangements have been made :—

October 25th.—Presidential Address by the Postmaster-General, followed by an Address on "Telephones, Provincial Organisation and Development," by Mr. R. A. Dalzell (Secretary's Office).
November 22nd.—"Telegraph Experiences in India," by Mr. J. J. Tyrrell (Central Telegraph Office).
December 14th.—Fifteen Minute Papers :—
"Supervision as Seen from Below," by Mr. S. A. Coase (C.T.O.).
"Phonograms," by Mr. B. R. Mead (L.T.S.).
"The Deficit on the Telegraphs," by Mr. W. H. F. Webb (C.T.O.).
January 24th, 1916.—"Public Administration and Finance. The Correlation of," by Mr. F. C. Cook (Accountant-General's Department).
February 28th.—"Loading of Telephone Circuits," by Mr. A. B. Hart (Engineer-in-Chief's Office).
March 27th.—"Telegraph and Telephone Work in a Provincial Depôt," by Mr. J. M. Rusk, of Stores Department, Edinburgh.
April 18th.—"Telegraph Tariffs and Economic Needs," by Mr. John Lee (Telegraph Traffic Manager, Secretary's Office).

Association of Electrical Station Engineers.—No particular arrangements made for the Session. Meetings will be held as and when required. Efforts are being made to hold regular meetings at the Newcastle and Manchester branches. Approximately 250 members are with the Forces.

Chemical Society.—The ordinary Scientific meetings will be held as usual, commencing with an informal meeting on Thursday, October 21st. Lectures have been arranged for as follows :—November 18th, by Dr. E. J. Russell; February 3rd, by Prof. W. H. Bragg; May 18th, by Prof. F. Gowland Hopkins.

Salford Technical and Engineering Association.—No alterations will be made. So far 35 members have notified the Secretary that they have joined the Forces.

Batti-Wallahs' Society.—The policy of the Society for the coming season has not yet been decided on. Out of a membership of about 250, between 40 and 50 are on active service.

Institute of Metals.—No alterations in arrangements consequent upon the war. The annual general meeting will take place as usual, in March, 1916, followed by the annual May Lecture in May, 1916. The number of members with the Forces is, approximately, 80.

Wolverhampton and District Engineering Society.—It is hoped to keep going as in previous years, but the syllabus is not yet prepared. Out of a membership of 150, 25 are with the Forces, and many, indeed most of the remainder, are engaged in different kinds of war work. There is, therefore, difficulty in securing suitable papers.

Nottingham Society of Engineers.—Consequent upon the war the meetings are being held monthly instead of fortnightly, and the number of works visits has been reduced. Approximately, 20 members are with the Forces. The society has proffered assistance to the local Munitions Committee. The President-designate, Brigadier Com. G. M. Jackson, is engaged on military service, and Mr. W. Ralph Bates (Alfreton Ironworks), a Life Vice-President, was elected President for the session 1914-15. The following arrangements are announced :—

October 20th.—"Steam Turbines, Blowers and Compressors," by Mr. J. Golder (Messrs. Fraser & Chalmers, Ltd.).
November 17th.—"Layout and Equipment of Engineering Works," by Mr. F. A. Garrett (Messrs Ruston, Proctor & Co., Ltd.).
December 15th.—"Steel," by Mr. A. W. Shepherd (Messrs. J. H. Andrew and Co., Ltd.).

Diesel Engine Users' Association.—Regular meetings recommence on October 20th, when there will be a further discussion on the lubrication of Diesel engines. Most of the Association's 50 members have important responsibilities at home in connection with the supply of electric power for public purposes and for war factories. Many are working in connection with the various Munitions Committees or are on special constabulary service. Among those engaged on Active Service with the Forces are Capt. W. E. Brandreth, of High Wycombe, the hon. sec., whose place during his absence is being taken by Mr. Percy Still; Mr. A. C. Gilling, of Epsom; Mr. T. E. Eachus, of St. Albans; and Mr. A. N. Rye, of Guernsey.

Greenock Electrical Society.—The first meeting of the session takes place to-night as announced in our "Forthcoming Events." The syllabus for the session contains many interesting papers and visits. Mr. W. B. Smith, A.M.I.E.E, chief assistant electrical engineer, Greenock, is the president for the ensuing session, and the hon. secretary is Mr. H. G. Wright, Electricity Offices, Greenock.

DECIMAL COINAGE AND THE METRIC SYSTEM.

Realising some time ago the extreme importance of removing every impediment to our foreign export trade, in order that we may be able to withstand the onslaught that Germany is sure to make upon us in the industrial war when "peace" is restored, the Editors of this journal took steps to ascertain the views of manufacturing firms belonging to or associated with the electrical industries, with regard to the desirability of adopting the metric system of weights and measures, so as to facilitate our dealings with countries in which it was in force. We also took the opportunity of putting questions to them on certain other points, which were embodied in the following circular letter:—

DECIMAL COINAGE AND THE METRIC SYSTEM.

Dear Sirs,

In our issue of August 13th (p. 214) we published a letter written by a British commercial traveller to the British Chamber of Commerce in Italy, in which it was pointed out that price lists and quotations in English coinage, weights, and measures were unintelligible to Continental buyers, and that it was impossible to secure their orders unless our offers were made in terms of decimal coinage and the metric system.

We have for many years supported this view, and have advocated the national adoption of the metric system not only as a key to the trade of the Continent, but also as an invaluable aid to the development of engineering trade with the whole world; if this course is not yet possible, there is at any rate nothing to prevent to use of the metric system in preparing catalogues, price lists, and quotations for foreign countries. Some British firms have already adopted this policy, with advantage to themselves, and we are desirous of ascertaining the extent to which it has been pursued, with a view to promoting its further development. We should be much obliged, therefore, if you would kindly furnish us with replies to the questions subjoined, which will form the basis of a future article in the Electrical Review:—

1. Do you employ the metric system in your correspondence with foreign clients?
2. Are your products
   (*a*) described in your catalogues in terms of metric weights and measures?
   (*b*) priced in terms of foreign coinage?
3. Do you employ the metric system in your workshops?
4. Are you in favour of the adoption in this country
   (*a*) of decimal coinage?
   (*b*) of metric weights and measures?
5. May we quote your name in referring to your replies in the Electrical Review?

We enclose a copy of the questions and an addressed envelope to facilitate reply, and trusting that we may be favoured with your kind assistance in this matter,

We are, dear Sirs,
Yours faithfully,
The Editors.

September 15th, 1915.

Some 450 copies of this letter were sent out, to firms representing a very wide range of interests; over 120 replies have been received, which we consider a very satisfactory proportion, having regard to the experience of everyone who has conducted a similar plebiscite, and to the heavy pressure of work on the shoulders of the majority of British manufacturing firms. While we have not space to deal with the replies individually, we propose to publish a selection of them, representing both sides of the questions under discussion, and to tabulate the results of the voting with fairness to both parties. Afterwards we hope to show good reasons for our belief that the adoption of the metric system and of decimal coinage would be of advantage to this country, and would not entail the expense and inconvenience with which the change is generally charged; but first we wish to express our cordial thanks to all those gentlemen, without respect to party, who have favoured us with their views on these important questions, and to add the hope that many of those who have not yet replied will kindly do so without delay—that they will sit down *right away* and do it before they forget. We should also welcome answers to our questions from any or all of our readers, particularly from manufacturing firms and others connected with the electrical industries. In view of the limitations of our space, we reserve our discretion as to the publication of letters on the subjects here dealt with, but while we ourselves are emphatically in favour of root-and-branch reform, we will publish a fair proportion of the arguments that may be put forward to the contrary. We will not, however, bind ourselves to insert any suggestions for tinkering with our existing weights and measures—we regard such proposals as tending to aggravate the trouble, and we stand for uniformity with other nations, or no change at all.

The following table summarises in briefest form the answers to our inquiries. Some explanatory comments will not be out of place. Obviously, our questions could not be detailed and verbose, and therefore could not cover a variety of contingencies; and the answers must be read in the same light, though in many cases detailed statements of great interest are made. Some of these will be reproduced in extenso later; at the moment we can only indicate the general tenor of the replies, and our method of construing them. For instance, in reply to question 3, some say "partly," others "yes"; we read both these as affirmative—the question was not meant to imply "to the exclusion of English measures," but to ascertain whether the metric system was used to any notable extent. Again, question 2 obviously relates mainly to catalogues destined for the perusal of foreign clients, and not necessarily to catalogues that are circulated only in this country. A firm that employs the metric system in correspondence with foreign clients "when this appears desirable" evidently *does* employ it, and the answer is "yes"; but where "no printed lists are current" we place the answer in the "doubtful" column. A firm that issues no price lists, but always quotes "in the language and coinage and measurements of any foreign country," obviously answers questions 1 and 2 in the affirmative. Where a firm states that in all its future catalogues the metric system will be used, the answer is taken to be "yes."

In many cases where the metric system is used in catalogues for foreign circulation, the local coinage is not used. This is often due to the fact that the rate of exchange varies, and hence it is not possible to quote fixed prices except in terms of English money. Another reason often given for not employing foreign coinage is that the business is done through local agents, who undertake the translation and printing of catalogues in their own languages; hence the British firm is not responsible for the production of these catalogues. Again, some firms report that their foreign trade is not considerable, and the question has, therefore, not arisen; in such cases their replies are entered in the "doubtful" column, which also contains replies in which the writer expresses no definite opinion or leaves the question unanswered.

Question.	Reply. Yes.	No.	Doubtful.
1. Do you employ the metric system in your correspondence with foreign clients? ...	86	25	10
2. Are your products			
(*a*) described in your catalogues in terms of metric weights and measures? ...	56	51	14
(*b*) priced in terms of foreign coinage?	41	62	18
3. Do you employ the metric system in your workshops?	61	54	6
4. Are you in favour of the general adoption in this country			
(*a*) of decimal coinage?	79	20	22
(*b*) of metric weights and measures? ...	87	21	13

From the foregoing table, it will be seen that the great majority of those who give definite replies use the metric system in their correspondence with foreign clients, more or less. Rather more than half give metric equivalents in their catalogues, in addition to English measures, or use the metric values alone. Only two-fifths price their goods in terms of foreign coinage; some of the reasons for this small proportion are given on p. 485, and must be admitted to be weighty. The majority employ the metric system to some extent in their workshops, as well as English units; a very few use the former almost exclusively; but nearly half the firms use English measures alone. Several report that no difficulty is met with in the use of the metric system.

The fourth question is one to which we attach great importance; the others relate to the existing practice of the writers, whereas the answers to the fourth tell us what they would like to do, and would do if everyone else would do the same. It will be seen that, excluding the doubtfuls, there is a majority of 4 to 1 in favour of the general adoption of decimal coinage and the metric system in this country.

(To be continued.)

THE MODERN ELECTRIC ELEVATOR.

In a paper presented at a meeting of the American Society of Mechanical Engineers, last year, Mr. David Lindquist, Chief Engineer of the Otis Elevator Co., outlined some of the peculiar features of modern elevator or lift practice, which on account of the many storied buildings met with in American cities, has been developed to a much greater degree there than in this country. The following is an abstract of certain portions of his paper:—

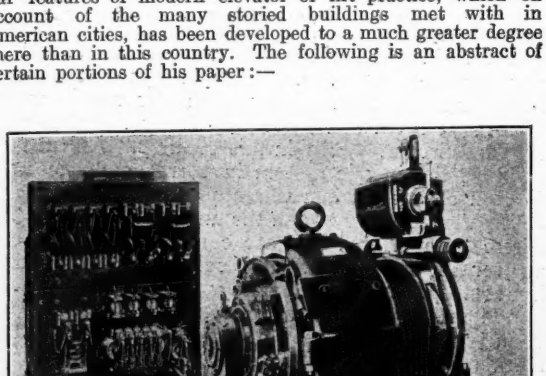
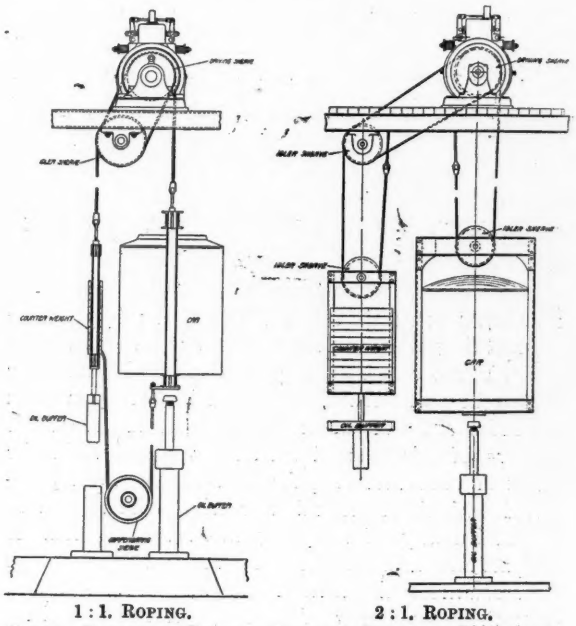


Fig. 1.—Overhead Installation of Gearless Traction Electric Elevator.

The most suitable arrangement when installing a traction electric elevator is to place the machine directly over the hatchway as shown in fig. 1. The advantages of so doing are better traction, less amount of rope, longer rope life, minimum space required, and higher efficiency. Placing the machine directly over the hatchway imposes a load on the building equal to the weight of the hoisting machine plus the loads on car and counterweight ropes, whereas placing the machine below imposes a load on the building equivalent to twice the loads on car and counterweight ropes. For a duty of 2,500 lb. at 700 ft. per min., the hoisting machine weighs about 16,000 lb., which is considerably less than the total load on car and counterweight ropes.

The roping of a so-called gearless 1:1 traction machine located overhead is very simple, as shown in fig. 2. The



1:1. Roping. 2:1. Roping.

Fig. 2.—Roping of Typical Gearless Traction Elevators.

successful use in an elevator of a slow speed electric motor directly connected to the driving sheave was first accomplished about ten years ago.

At first glance it would appear as if the traction drive would be uncertain, the ropes on the driving sheave depending solely upon friction.

Before any of these traction machines were put on the market, a large number of tests were made under such variable conditions as would be encountered in actual installations. It was found that with one-half wraps around the driving sheave, the maximum traction relation—that is, the relation between the load on the heavy side of the ropes to that on the light side—was 1.56, and the minimum traction relation, with one-half wraps, was 1.4. With two half wraps the maximum relation is 2.43 and the minimum 1.96.

The maximum was obtained with a new turned sheave with practically new ropes and without any lubrication. The minimum was obtained with smoothly-worn sheave and ropes well lubricated, and with comparatively light tension and high speed. The principal reasons for this result are that with light tension and high speed there is an oil film between the rope and the sheave; moreover, the rope does not make contact over fully 180 deg. with the sheave, due to the stiffness of the rope and centrifugal action.

Under ordinary conditions a 1:1 traction machine is usually provided with six ropes, ⅝ in. in diameter. The material is of soft steel, and in actual installations this will give a safety factor of not less than twelve.

Each rope is provided with a self-adjusting swivel rope hitch of the ball and socket type. This permits a gradual creeping and thus prevents any excessive twisting strain, and relieves the rope of the bending strains at the hitch, principally caused by vibration.

Traction elevators are arranged so that in case of overrun at terminals, either the car or counterweight bottoms on a buffer, thereby reducing the traction sufficiently to prevent further motion of the car and counterweight even if the motor keeps on running.

The buffer is usually an oil buffer of a spring-return type placed in the bottom of the pit.

In very high lifts the rope weight will cause considerable traction, which with the momentum of the car or counterweight may cause either of them to travel into the overhead work, and therefore a retarding and latching device is fitted at the top of the hatchway for both car and counterweight in addition to the buffers in the pit. The counterweight equals in total weight the weight of the car plus usually about 40 per cent. of the maximum load. In an elevator of 2,500 lb. lifting capacity this equals 1,000 lb. (the overbalance), which represents six or seven people. With these in the car giving balanced conditions, the only power required would be for acceleration, friction and electrical losses.

It is obvious that with a high rise elevator the variation in

the net load on the elevator machine due to the shifting of the weight of the hoisting ropes from one side to the other of the driving sheave as the car moves up and down, would be excessive if this were not compensated for. This compensation is usually obtained by means of chains or ropes attached to the car and counterweight, and running down the hatch in a loop.

The weight per foot of these compensating ropes is such that they, together with the electric cables (that lead to the car), will compensate the weight of the hoisting ropes regardless of the position of the car.

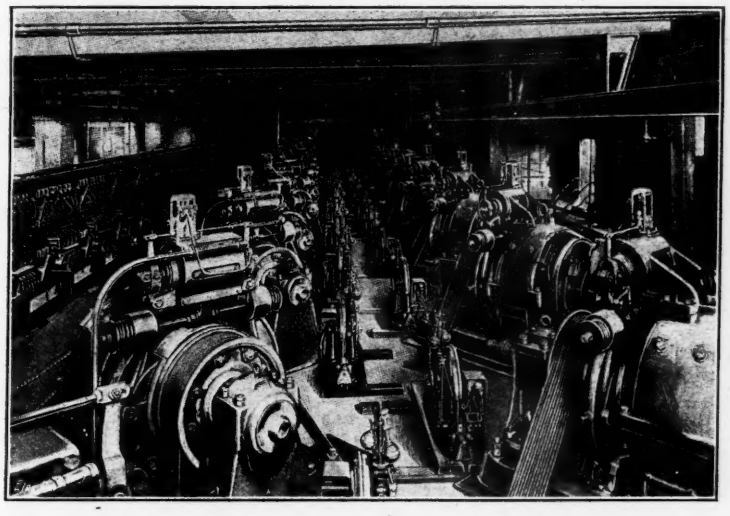


Fig. 3.—Installation of Traction Electric Elevator Machines with Plain Babbitted Bearings.

For all high speed high rise elevators, compensating ropes are used. In the pit a tension device is provided for the compensating ropes. For moderate rises and comparatively slow speeds, chains may be used instead of ropes.

The motor is of the slow-speed type, generally six-pole and usually provided with shunt field only; the armature is series wound with rectangular cross section conductors. With a 36-in. driving sheave, a car speed of 600 ft. per min. corresponds to 63.6 r.p.m. of the motor. This type of motor for the gearless elevator has a high efficiency at light loads, which is advantageous where the average motor load is usually less than one half its rating. A motor installed in the Metropolitan Life Tower, rated at 38 h.p., has a full load efficiency of 89 per cent.; 91.5 per cent. at half load, and over 90 per cent. at quarter load. The speed is 58 r.p.m. at 110 volts. The driving sheave and brake wheel are of the rim type cast integral and bolted to the armature sleeve or spider. Circular rope grooves are employed. The brake is of the shoe type, and the magnet is usually provided with series-winding for quick release, and with a shunt-winding for holding. The brake shoes are provided with a lining of fabricated asbestos. A gradual and soft application of the brake is obtained by a particular method of magnetic retardation of the magnet cores, eliminating thereby the necessity for dash pots. A characteristic of the brake lining is that the friction is practically constant; with leather the friction coefficient decreases with the speed, which leads to creeping of the machine.

Bearings of the self-aligning type, and ball and roller bearings are used; the latter save space and often eliminate the necessity for double decking the machines.

In the case of elevators with 2:1 roping, the saving in space in connection with the sheaves becomes a necessity; for particularly in the counterweight sheave a plain babbitted bearing of suitable size would be almost impossible.

The author considers ball bearings superior to roller bearings for elevators; they can run slightly out of alignment without causing destructive strains or excessive friction, and will resist a certain amount of end thrust, which is not the case with roller bearings.

The principal loss in ball bearings is that caused by the viscosity of the lubricant and increases greatly with speed. It is partly due to churning and partly to the force necessary to squeeze the lubricant out of the path of the balls; the main use of the lubricant is to protect against corrosion.

For slow-speed bearings a moderately heavy grease which will not flow is the best.

The speed variation necessary in connection with high-speed traction elevators is obtained, partly by field regulation and partly by series and by-pass resistance in the armature circuit. The field regulation is usually capable of reducing full speed down to a speed from 60 to 40 per cent. of full speed; further slow-down is obtained by resistance control.

The combination of the two methods mentioned is necessary for obtaining sufficiently slow car speed (about 90 ft. per min.). This slow speed is required for making accurate stops both at intermediate and terminal landings, and also in order to make a very short travel, or to "inch" up or down, to the landing. The exceedingly slow speed automatically obtained when approaching terminal landings is necessary not only to secure accuracy of stops with varying loads, but to provide a fundamental safety feature. It may be mentioned that anti-friction bearings not only materially aid in obtaining smoothness of operation but greatly facilitate the "inching" up to the floor landings.

As a matter of fact, the 1:1 electric traction machine with ball bearings has practically the smoothness of motion so much appreciated in hydraulic elevators.

In connection with the regular operating features of the control apparatus, there are also a number of other features introduced for the purpose of safety. Some of these may be merely mentioned without going into too great detail:—

(*a*) Automatic return of car switch to "off" position.

(*b*) Automatic stopping switch on car for automatic stopping at terminal landings.

(*c*) Final cut-out limit switches in hatchway operating independently of the automatic stopping switch.

(*d*) Switches operated by centrifugal governor automatically stopping the elevator in case of overspeed; the first switch cuts the power off from the machine and applies the dynamic brake effect to the armature, and the mechanical brake to the brake pulley; the second switch applies the light retarding force to the car safety referred to later.

(*e*) The safety switch in the car under the control of the operator also performs the same function as the two switches operated by the governor.

(*f*) Regulation of the shunt field by centrifugal governor to maintain constant full speed with variable loads.

(*g*) Oil buffers, previously mentioned, capable of independently stopping the fully loaded car when descending at 50 per cent. excess speed without discomfort to the passengers.

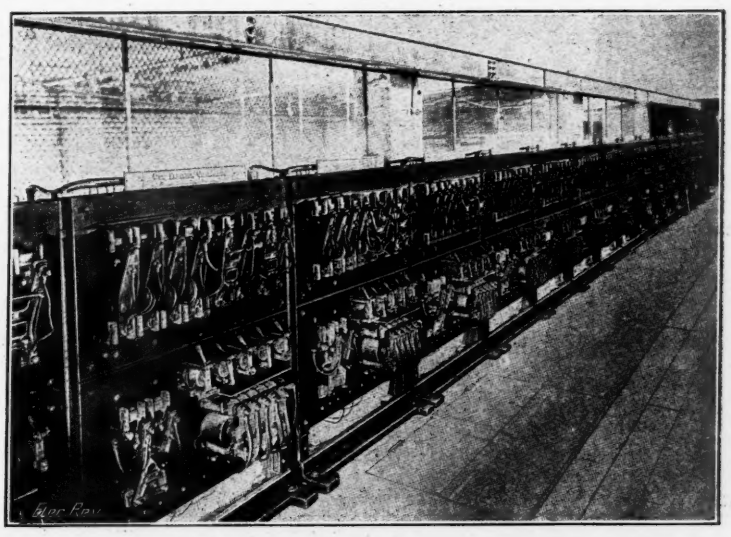


Fig. 4.—Group of Traction Elevator Machine Controllers in Overhead Installation.

(*h*) For high rise elevators the use of a mechanical retarding and latching device.

Gearless traction machines, utilising 1:1 or 2:1 roping, have been built for loads varying from 2,000 to 11,000 lb. at car speeds of 350 to 700 ft. per min. Of these duties the most generally used for the modern high office building, utilising 1:1 roping, is about 2,500 lb. at 600 to 700 ft. per min., although in many cases a speed of 500 to 550 ft. per min. is found suitable.

The high rise elevators in the Woolworth Building, N.Y.,

have a speed of 700 ft. per min.; in the new Equitable Building, N.Y., some of the express elevators travel part way at 650 ft. and the remainder, on local service, at 550 ft. per min., the speed change being automatic.

The curves in fig. 6, produced from elevator tests, show the relation between time and speed, for express runs and for stopping at every floor. The maximum speed in the latter case is only about 70 per cent. of express speed. This is, however, rather an extreme case, as the car was heavy and the ropes long.

For moderately high buildings a 2 : 1 roping is suitable for a car speed up to 450 ft. per min. Machines of the geared type are most suitable when lower speeds are involved or where service conditions are not so severe; they can never equal the gearless type in smoothness of operation. Two

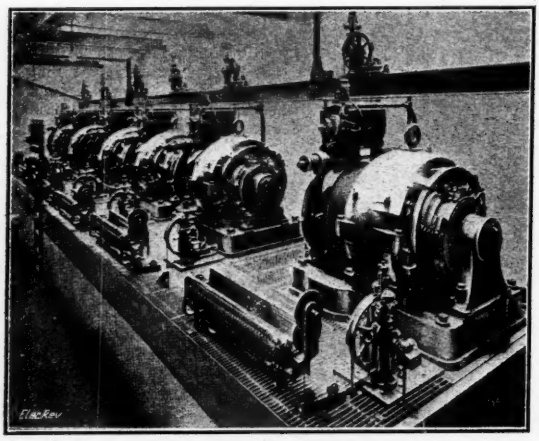


Fig. 5.—Installation of Ball-bearing Traction Machines.

geared types have been developed, employing worm and herring-bone gear reductions.

The former is used extensively for slow and moderate speeds; the herring-bone gear is somewhat more efficient and has been used with some success on quite high speed elevators.

The worm gear has inherently less tendency to vibrate than the herring-bone gear.

Tests on one of the latter gears (9 : 1) showed a loss of 1.5 h.p. at a speed corresponding to a car speed of 500 ft. per

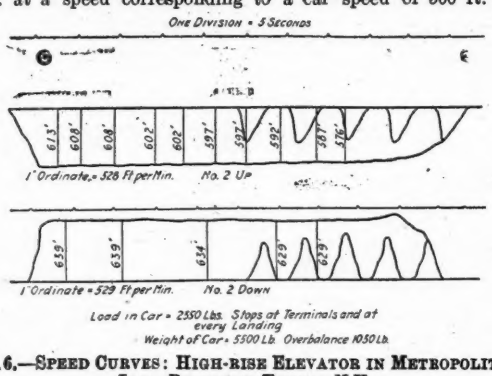


Fig. 6.—Speed Curves: High-rise Elevator in Metropolitan Life Building Tower, N.Y.

min., due principally to the churning of the oil. If the oil is taken out of the gear case and the gear sprayed with sufficient oil to prevent cutting, the efficiency becomes practically the same at different speeds, being a little over 90 per cent.

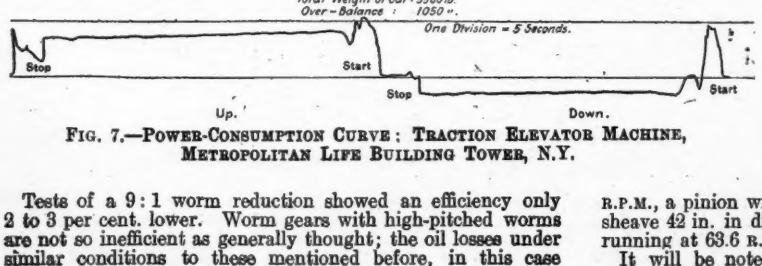
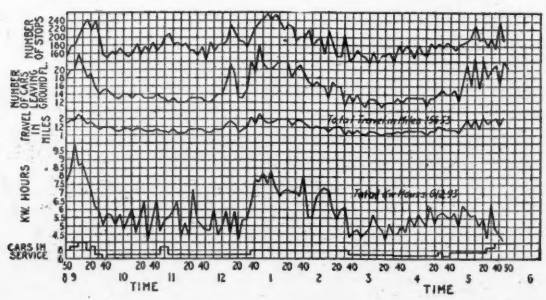


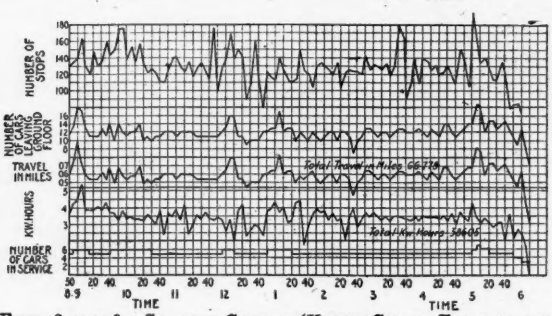
Fig. 7.—Power-Consumption Curve: Traction Elevator Machine, Metropolitan Life Building Tower, N.Y.

Tests of a 9 : 1 worm reduction showed an efficiency only 2 to 3 per cent. lower. Worm gears with high-pitched worms are not so inefficient as generally thought; the oil losses under similar conditions to these mentioned before, in this case also reach about 1.5 h.p.

Considerations of power consumption in the machine may be divided into three parts relating respectively to motor efficiency, gear efficiency, and inertia. The efficiency of the high-speed motor used with the geared machine is at normal loads less than that of the motors used with the gearless elevator, although its maximum efficiency may occasionally be as high.

An equal amount of field regulation may be applied to both high and slow-speed motors. The high-speed motor machine has under best conditions a gear loss of about 10 per cent., which is eliminated in the case of the gearless type.





Figs. 8 and 9.—Service Curves (Upper Chart Express, and Lower Chart, Local Service), for Elevators in Hudson Terminal Building, N.Y.

Kinetic energy, although the most important factor in power consumption, has been little considered, probably, owing to the difficulty in determining its amount in a complex elevator machine.

An idea of the relatively high cost of operation of electric elevators, utilising high-speed motors with gears, may be gained by means of the following example: Assume a weight of 1 lb. revolving at a radius of 9 in. at 800 r.p.m. (which is the speed usual with motors for worm gear machines). The kinetic energy to be imparted to this weight each time it is started from rest and brought to full speed will then be 61.3 ft.-lb.

If the elevator starts on an average of 4,500 times per day and runs 300 days per year, the cost of the energy absorbed for acceleration, at 4 cents per kw.-hr. would amount to $1.25 per lb. per year. If, instead of one lb., the weight were 219 lb. (which is the effective equivalent weight of a particular herring-bone gear machine), the cost would be $273.00 per year.

Of course, part of the kinetic energy required for starting is returned at the time of stopping, but, on the other hand, the starting efficiency is low, since a large amount of the power is lost in the starting resistance and some in the motor. The loss in the starting resistance and motor is certainly larger than the energy recovered at the stop, and hence the cost per year for accelerating and retarding 219 lb. of weight, under the above conditions, would amount to more than $273.00.

In ordinary passenger service the loads taken up and down are practically the same: the electric power is not primarily required for passenger transport but to overcome friction and supply the kinetic energy for each start less the amount recovered at the stop. The friction losses are by far the smaller of the two; therefore a comparison of the kinetic energies of two elevators in the same service, with the same method of control, gives a good idea of what their relative power consumption and rapidity of acceleration will be in actual service.

In the following tabulation are given the kinetic energies of two traction machines, one with herring-bone gear and the other gearless, both built for a car speed of 600 ft. per min., and for the same load. The herring-bone gear machine had a motor running at 505 r.p.m., a pinion with 23 teeth, gear with 213 teeth, and driving sheave 42 in. in diameter. The gearless machine had a motor running at 63.6 r.p.m. and a 36 in. driving sheave.

It will be noted that the kinetic energy per start of the herring-bone machine would be about 5.5 times that of the 1 : 1 gearless machine. Consequently, if the cost of power for accelerating and retarding the 13,400 ft.-lb. of the former amounts to $273 per year, the cost for the gearless machine would be $50.

Herring-bone Gear Machine.

	Kinetic energy in ft.-lb.
Motor armature	7,420
Brake pulley	2,920
Driving sheave	1,000
Herring-bone gear	2,060
Total	13,400

Gearless Machine.

Armature, brake pulley, driving sheave	2,450

The increased kinetic energy of the geared machine is not directly proportional to the speeds of the motors employed in the respective types, because the ratio between the kinetic energies of the driving sheave, brake and gear coupled to the motors is considerably less than proportionate to the motor speeds. If the armatures only are considered, the kinetic energy is more than proportional to the speed because the geared machine requires a larger motor on account of gear losses.

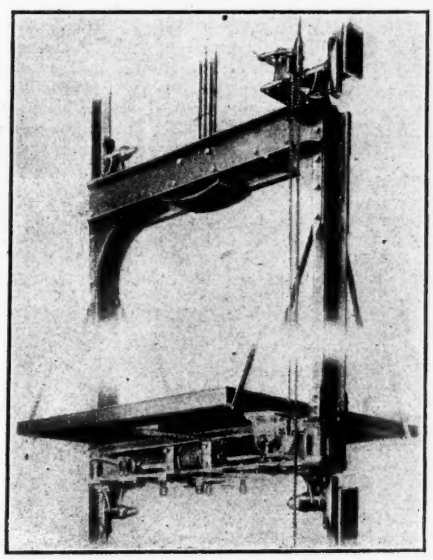


Fig. 10.—Arrangement of Wedge-clamp Safety.

The maximum efficiency of a gearless traction elevator in a New York telephone building, from line to load, allowing for all losses is over 71 per cent.; similarly, the maximum efficiency of a complete elevator with herring-bone gear machine in the New Yale Club building, N.Y., is about 62 per cent.

The two charts (figs. 8 and 9) show actual service conditions at the Hudson Terminal building, N.Y., which are severe and varied. In order to prevent congestion in a building, the elevators must be capable of taking care of at least half or, say, two-thirds of all the people in the building during practically ten minutes. High speeds must be maintained during rush hours; in this respect the electric elevator has the advantage over the hydraulic elevator, as the latter has its minimum speed when fully loaded.

Fig. 10 illustrates the safety device usually employed until recently on elevators; it is the standard so-called wedge clamp safety, which clamps the rails for retarding and holding the elevator car in case of overspeed or free fall. Present practice utilises the same principle of application whether the safety is actuated under conditions of excessive speed with ropes intact or during free falling. A very strong retarding force is required to stop a free falling car, but if this is applied with ropes intact and is excessive the passengers will get an unpleasant shock.

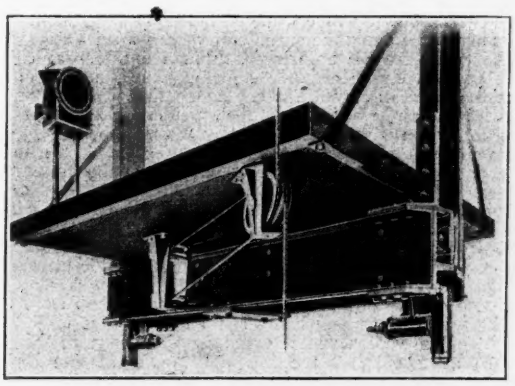
For the above mentioned reasons, it is essential, therefore, that the safety should apply a strong retarding force in case of a free falling car with ropes parted, and a light retarding force in case of overspeed with ropes intact.

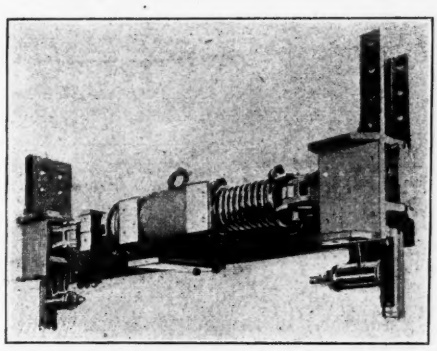
Figs. 11 and 12 show the general features of an electro-mechanical elevator car safety, which embodies all of the above described requirements. The light retarding force is obtained by means of a helical steel spring forcing the wedges between the rollers of the safety jaws. When the car is in service this spring is held under compression by means of an electro-magnet. The instant the current in this magnet is interrupted, either by the centrifugal governor, safety switch in car or limit switches in the hatchway operated by the car or counterweight, the light retarding force is applied.

The strong retarding force is obtained by revolving the safety drum, thereby actuating the right and left-hand screw, which in turn moves the wedges and forces the jaws against the guide rails. The strong retarding force is definitely determined by the number of turns around the safety drum, which vary in number according to the maximum load and the amount of the safety rope tension weight.

The releasing carrier is placed on the counterweight and will therefore apply the strong retarding force of the car safety, even though the releasing carrier fails to release, due to faulty adjustment. The strong retarding force only is applied to the counterweight safety.

Whenever the current is cut off from the elevator, the electrical parts of the safety are operated, thereby applying the light retarding force. The mechanical actuating parts of the safety effecting the strong retarding force are continually kept in slight motion when the elevator is in operation, due to the different stretching of the hoist and governor ropes. A device of the kind described has been fitted by the Otis Co. to some 49 elevators in the new Equitable Building, N.Y., with very successful results.





Figs. 11 and 12.—Detail Views of Electro-Mechanical Safety applied to Car.

A THERMOSTAT FOR MODERATE AND HIGH TEMPERATURES.

By J. L. HAUGHTON, M.Sc. and D. HANSON, M.Sc., both of the National Physical Laboratory.

(*Abstract of paper read at the Autumn Meeting of the* Institute of Metals.)

In the investigation of alloys with a view to establishing their diagram of thermal equilibrium, it is often necessary to maintain the specimen at a more or less constant temperature for several hours, or even days or weeks.

For low-temperature work this is a very simple matter; the problem, however, becomes much more difficult when higher temperatures are required. Up to 300 deg. C., it is possible to make use of the differential expansion of metals; but above that temperature oxidation effects become serious unless the more expensive metals are used. D'Arsonval has used an air

bulb working into a corrugated plate, such as that employed in an aneroid barometer, the motion of the plate being used to regulate the supply of gas to the furnace. A similar arrangement is described by Mellor for use with an electric furnace, the expansion of the air being employed to break a circuit through a relay which switches off the main furnace current. Both these forms of apparatus suffer seriously from the fact that they are not independent of atmospheric pressure, and they have therefore to be adjusted with changes in the barometer.

Without being aware of the existence of either d'Arsonval's or Mellor's instruments, the authors attempted to solve the problem on similar lines. In the first apparatus that they constructed, a glass bulb was placed in the furnace, the bulb communicating with a U tube containing mercury. The use of glass necessarily limits the temperature attainable to about 500 deg. C., but it was considered better to experiment with glass before incurring the expense of making a silica apparatus.

The tube from the bulb leads, through a three-way cock A (fig. 1), to a U-tube containing mercury. By means of the cock the tube can be put into communication with the U-tube, or with the air, while the U-tube itself can also be put into communication with the air, the way to the bulb being, under these circumstances, closed. Another three-way cock B serves to connect the other limb of the U-tube with the air or with a second bulb C, which is kept at a constant temperature by being immersed in a "Thermos" flask filled with ice. A platinum wire D, sealed through the wall of the U-tube, and prolonged downwards inside it, makes permanent connection with the mercury, while a similar wire E, on the other side, and at a point where the tube is constricted, makes contact with the surface of the mercury of the other limb as it rises in the tube, the contact being again broken as it falls. The height of the wire E and the amount of mercury in the tube are so arranged that the pressure in the furnace-bulb is

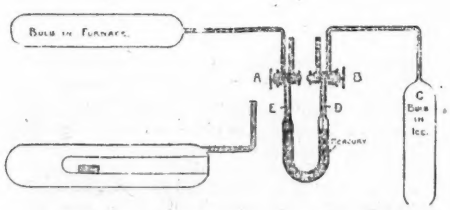


Fig. 1.—Complete Thermostat, and Modified Bulb.

slightly less than atmospheric, so that should a break occur in that bulb the current would be switched off; a fall of temperature being, in the majority of cases, a lesser evil than a rise.

The three-way cocks, though not necessary, render the adjustment of the temperature a matter of great ease. The use of a completely closed apparatus overcomes the difficulty of barometric influence, while immersing the outside bulb in ice neutralises the effect of changes of room temperature.

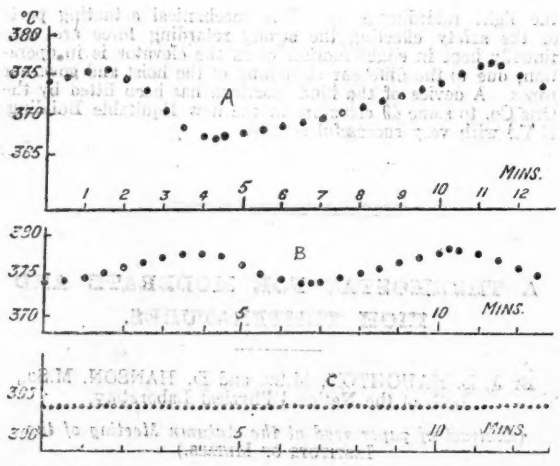


Fig. 2.—Temperature Curves.

The mercury-switch operates a relay in which a solenoid pulls a fork into or out of two mercury-cups. The whole apparatus (furnace, relay, etc.) is run off a 100-volt circuit. As first set up the relay controlled the whole current to the furnace—a current far in excess of that necessary to give the required temperature. With this arrangement the apparatus worked very badly, the temperature "hunting" over a range of about 50 deg. C. This was doubtless due to the large thermal lag between the furnace walls and the air-bulb, which enabled the excessive current to heat up the former to a very considerable extent before the latter operated the mercury control. On rearranging the apparatus so that only a definite amount of the current was cut in or out, leaving the maximum current not very much in excess of that necessary to heat the furnace to the required temperature, the uniformity was greatly improved, and fig. 3A shows the temperature curve obtained.

At this point it occurred to the authors that much better results could be obtained by placing the specimen in the middle of the bulb, so that the heat would have to pass through the air of the bulb before reaching the specimen. In this way the lag of the air-bulb would be utilised to reduce the fluctuations of temperature in the specimen, instead of accentuating them, as in the older form. For this purpose a glass vessel was made of the form shown in fig. 1. This was built into an electric resistance furnace, the heating wire being wound on to asbestos paper wrapped directly on the glass. This form of thermostat gave the curve of fig. 3B. It will be seen that the temperature fluctuations of the specimen have been reduced from about 10 deg. to about 4 deg. C. by this modification.

Alterations were then made in the amount of resistance cut into and out of the furnace by the relay. This was arranged so that the variations in current caused by the relay were just amply large enough to cover the range of accidental variations. This produced a further very considerable improvement in the working of the apparatus. Finally, the tube containing the specimen was plugged with asbestos in front of, and behind, the specimen, with the result that the curve shown in fig. 3C was obtained.

It was hoped to replace the glass vessel by a silica one, in order to enable work at a high temperature to be carried out; but pressure of other and more important work has made it necessary to postpone this indefinitely. Dr. Mellor found that his apparatus gave three times as great a variation at 700 deg. as at 400 deg. C., and he attributes this to the greater effects of lag at high than at low temperature. In the present form of apparatus this difficulty should be completely overcome.

It was always found that when a new bulb was put into the furnace the temperature was inclined to rise for a few weeks. For a day or two the rise was quite rapid—of the order of 5 or 10 deg. C. per day. This gradually fell off, and eventually the temperature steadied down. This conduct was all the more remarkable inasmuch as the apparatus was working under a slightly reduced pressure, and yet a rise of temperature could only be produced by a further reduction of the pressure. There is little doubt that this effect is caused by the ageing of the glass, which would be fairly rapid at the temperature at which the thermostat was working. The phenomenon is indeed identical with the ageing of mercury thermometers.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Electrically-driven Dough Mixer.

The Swedish General Electric, Ltd., of Canada House, Kingsway, W.C., are the sole agents for the Century motors, which they stock.

The accompanying figure shows a "Century" 7½-H.P. single-phase repulsion induction motor, coupled through spur gearing to a heavy dough mixer. The application of single-phase, alternating-current motors to machines requiring a heavy

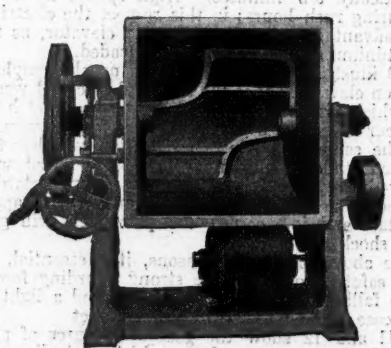


Fig. 1.—Century Single-phase Motor driving Dough Mixer.

starting torque in the case of small motors has usually involved the fitting of loose pulleys, friction clutches or similar unloading devices, all of which are open to the objection that they are expensive to install and maintain. Century motors can exert a starting torque equal to about 2½ times the running torque, and

consequently, a machine taking, say, 1 H.P. to start it, and ½ H.P. to run it, can be adequately driven by a ½-H.P. Century motor.

The Century Co. have recently introduced a completely new series of fractional H.P. motors, known as Type M, for all frequencies from 25 cycles to 60 cycles, and in sizes varying between $\frac{1}{70}$ H.P. and ½ H.P. They have the same characteristics as Type P motors, which have already been sold on this market for over 10 years.

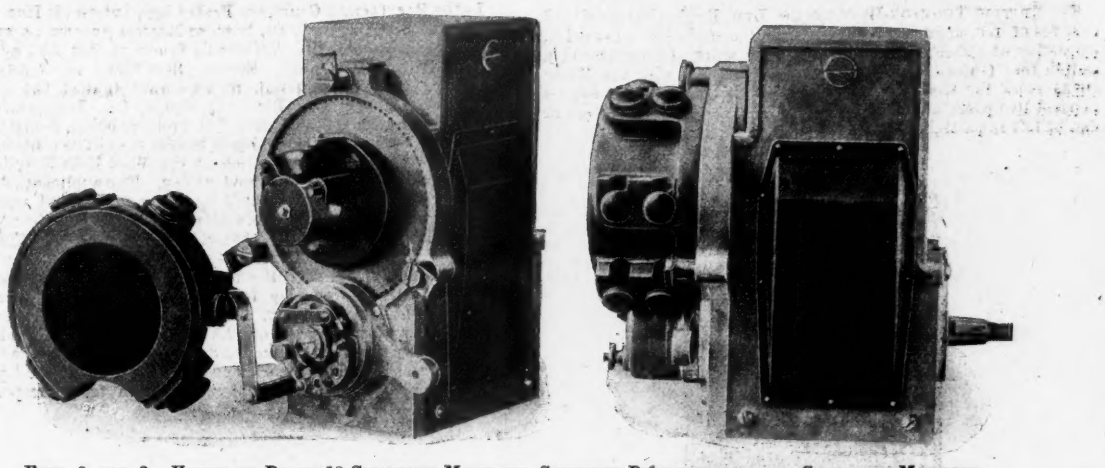
A Magneto for 12-Cylinder Engines.

The introduction of the 12-cylinder engine has brought in its train the Dixie 12-cylinder magneto, which is said to be the first practical commercial 12-cylinder magneto to be offered having a single unit distributor. It is to be known as the "Dixie 120," and in construction it follows closely that of the "Dixie 40." There is no rotating wire-wound armature, and the usual high-pressure collector, with its attendant brushes, is eliminated.

distributing finger attached to the distributor gear, thereby eliminating all double distributor blocks, or the necessity for complicated brushes or other mechanism in the high-pressure circuit between the distributor and the generating windings.

The breaker contacts operate at 12-cylinder engine speeds in excess of 300 times per second, the vibrations of the breaker arm exceeding in speed the vibrations of the middle C string in a piano; in fact, the magneto, when running at maximum speed, gives a clear musical note. The magneto produces four sparks per revolution, and is geared to the engine 1½ times engine speed; by an ingenious device, practically any degree of advance or retard is accomplished, the intensity of the spark being the same at either advance or retard for any given engine speed.

Owing to the fact that the "Dixie 120" has no rotating wire-wound armature, or other parts that would not stand up under excessive speed, the Dixie may be driven at a speed of 5,000 R.P.M. indefinitely, at which speed 20,000 sparks per



Figs. 2 and 3.—Views of Dixie 12-Cylinder Magneto, Showing Distributor, and Complete Machine.

The distributor, as shown in the accompanying views, figs. 2 and 3, is no larger in diameter than the usual 4-cylinder distributor. It has, however, two rows of contacts, six contacts in a row, and the spark-plug cables are connected to these contacts by means of the usual outside terminals. Travelling round and wiping over each row of contacts is a separate brush, and connected to each of these brushes is an auxiliary brush, so arranged that the high-pressure circuit is connected first to one travelling brush and then to the other. At no time are both brushes alive, and, consequently, the separation of the various contacts in the distributor is maintained at such a value that jumping and misfiring are prevented.

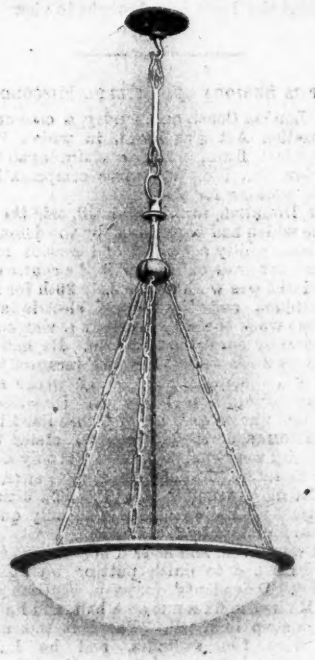


Fig. 4.—Ediswan Semi-Indirect Lighting Fitting.

The two rotating brushes in the distributor carry the same polarity, and therefore there is no tendency for a breakdown to occur between them.

From the foregoing it will be seen that in this 12-cylinder distributor there are four rotating brushes carried on a single movable

minute are produced, and these are in perfect synchronism, and of the same intensity at any given engine speed with the magneto to full advance or retard, over a spark range, usually of 40° to 60°. A 12-cylinder four-cycle motor fires six cylinders per revolution of the crank shaft, and sometimes reaches a speed of 3,000 R.P.M.; hence the interruptor must function at the rate of 300 times per second. The difficulty of overcoming the inertia of a breaker mechanism which must operate at such a tremendous number of current ruptures per second has caused the designers of the "Dixie 120" to double the number of working parts, this halving the number of movements of each part. A pair of breaker bars is used, one superposed on the other, and acting independently, the motion being transmitted by a double cam side by side with the rotor shaft, with the cam faces acting alternately first on one and then on the other bar, rupturing the primary current delivered to a common "anvil" containing two independently adjustable platinum-pointed screws.

The sale of the "Dixie 120" in Europe is controlled by the American Supplies Co., Ltd., of 162, Great Portland Street, London, W.

Ediswan Lighting Fittings.

The Edison & Swan United Electric Light Co., Ltd., Ponder's End, Mdx., has issued a new finely-illustrated catalogue of Ediswan electric light fittings. Since the issue of its last list the company has had a largely increased turnover in fancy fittings,

Fig. 5.—Three-Light Ediswan Ceiling Fitting.

and has therefore decided to keep a larger assortment of stock designs. These are excellently shown in the catalogue now before us, which consists of more than 180 pages of art paper, and contains getting on for 500 illustrations. The contents are well arranged, the illustrations well executed and conveniently indexed

both as to sections and numerically. The book is the best Ediswan catalogue that we have seen for many a day, and no doubt it will bring its reward.

The fittings, which cover a wide range, are classified under various headings, such as pendants, brackets, ceiling fittings, electroliers, standards, lanterns, semi-indirect fittings, &c. All of the designs shown can be seen at either of the company's London showrooms (123/125, Queen Victoria Street, E.C., and 71, Victoria Street, S.W.), and for the convenience of contractors and others there is a number of introduction slips for clients to present at those showrooms, included at the end of the book. Selections of the fittings may also be seen at the branch depôts.

We select for illustration a couple of typical examples of fittings shown in the catalogue, fig. 4 being representative of the semi-indirect lighting section, and fig. 5 a three-light ceiling fitting, in polished brass with crystal cut glass.

Motor Control Panel.

The British Thomson-Houston Co., Ltd., Rugby, has developed a series of D.C. motor control panels, as shown in fig 6 herewith, consisting of a sheet steel base carrying a starting rheostat and a switch fuse (shown open), the whole complying with the Home Office rules for the use of electricity in factories; there are no exposed live parts, and neither the starter nor the switch fuse can can be left in partial contact.

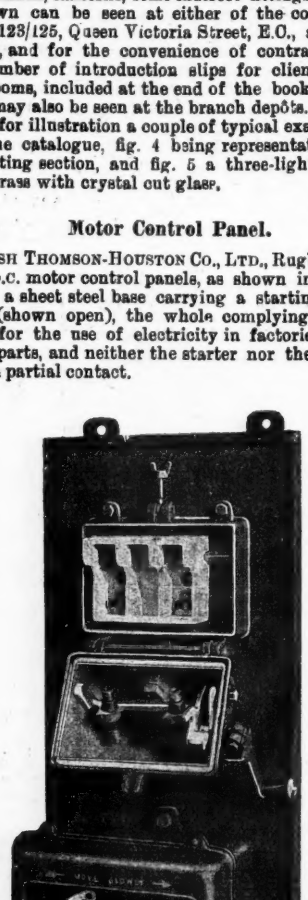


Fig. 6.—B.T.H. Motor Control Panel.

These panels are made for motors up to 7½ H.P. on circuits between 100 and 550 volts. The fuses are of the "bomb" type. The panels are described in Price List No. 3,260.

Lighting of West African House.—Messrs. E. P. Allam and Co. inform us that the whole of the wiring installation at West African House was carried out by them, and all the "Eye-Rest" fittings were fixed by them; while in small rooms the lights are, as stated by us last week, controlled by a single switch, in the larger room the lighting points are grouped under the control of two or more switches.

LEGAL.

Workmen's Compensation Claims.

An unsuccessful claim under the Workmen's Compensation Act was brought at the Warrington County Court on the 7th inst. by Sydney Bodle, 17, of Warrington, against the St. Helens Cable and Rubber Co., Ltd. He claimed for the loss of his left hand as the result of an accident which occurred at the respondents' works on April 26th last.

On April 6th Bodle was engaged by the firm at a wage of one guinea per week, with a war bonus of 10s. per month, to do whatever was required of him. On the 26th of the month he got his hand caught in a mixing machine, and the limb was so severely injured that it was necessary to amputate it. The point at issue was as to whether or no the accident arose out of, and in the course of, his employment. For the applicant it was contended that he went to the mixing machine for the purposes, and for the benefit, of his employers, and that he was not acting outside his duty. On the other hand, the respondents' legal representative argued that on the applicant's own admission he was engaged to do whatever work was required of him, and that, inasmuch as the work of feeding the mixing machine was skilled and was not found for him, it was evident that he was doing something he had no right to do.

This contention was upheld by Judge J. Scott Fox, K.C., who found that the applicant had not made out his case, and who accordingly gave judgment for respondents, with costs on Scale B.

In the Bow County Court, on Friday last, before his Hon. Judge Smyly, K.C., sitting with Dr. Bate, as Medical Referee, an application was made under the Workmen's Compensation Act, by David James Drury, of Oxford Street, Stratford, an electrician's labourer, for the continuation of an award against the Charing Cross, West End and City Electricity Supply Co. It appeared that on February 18th the applicant fell from a boiler, a distance of 22 ft., and broke his shoulder blade, besides sustaining other injuries. He was treated for a long time at the West Ham Hospital, and had attended there only the previous day. The applicant admitted that he had been offered work by the company, but was quite unable to do it. He was quite a nimble fellow before the accident, but to show how bad he had become he was refused for the Army as being quite unfit. Dr. Howitt, for the respondents, said the setting of the fractured collar bone had been very badly done, but it did not prevent free play for the shoulder. He considered the man quite fit to do his work. The respondents paid compensation up to July and then ceased, and he considered the man could have worked after that had he liked to do so. Judge Smyly decided that the man was now fit for work, and as the respondents had paid in a sum up to October 5th, he entered judgment for the respondents, with costs.

Unobscured Lighting.

At Wallasey Police Court on October 6th Henry Weissenberg, of North Drive, New Brighton, was summoned for having unobscured lights in his house visible from the sea, on September 21st. It was stated by Arthur Lodge, of New Brighton, that on the evening of the 21st ult. he saw an intermittent exhibition of electric lights from the kitchen of the defendant's house. He last saw the light about 8.30 p.m., and informed the police. Defendant said he had been in England 40 years, and had lived at New Brighton for 25 years. There were two lights in the kitchen of his residence each of 16 C.P. He was ignorant of the light being visible at the time, but had ascertained that the cook had opened the fanlight and the wind caused the blind to wobble, and every time the blind wobbled the light was brought to view. A fine of £10 was imposed.

What is Serious and Wilful Misconduct?

In the City of London Court, on Monday, a case under the Workmen's Compensation Act was heard, in which William James Vasse, an electrical fitter, made a claim against the British Thomson-Houston Co., Ltd., to recover compensation for injuries sustained while working for them.

Mr. J. Scott Duckers, for the plaintiff, said the only difficulty was the defence which had been raised by the defendants that the plaintiff had been guilty of wilful and serious misconduct, and whether the accident arose out of, and in the course of, the employment. The plaintiff was working on July 20th for the defendants at the Twickenham and Teddington electric supply station. While doing some work there he received a shock at 3,000 volts, and was very severely burned on the arm. He had recovered, and he had got back to work after 11 weeks' incapacity. All he was claiming was £11 compensation for 11 weeks at £1 a week, although he was earning over £4 a week. He was only entitled to £1 a week. There was no question of future liability.

Mr. Ralph Thomas, defendants' counsel, stated that so far as period of incapacity was concerned, there was only a question about one week, and, therefore, the defendants were agreeing the period at 11 weeks. He did not admit the plaintiff's estimate of £4 as being his average weekly earnings. The only questions for the Court were those indicated by Mr. Duckers.

The plaintiff was called, and he said he was sent to Twickenham to finish a job. He had to finish putting up an earth strip for earthing current. Defendants' foreman, McLean, gave him his instructions. He had to fix a nut on a bolt, and he had to fix the end of the earth strip in a cell. The bolt was fixed inside the cell. There were two switches, and he had to get in between them. The bolt was between the two switches. He thought his hand must have been drawn towards one of the switches because he did not know much else until the accident happened. He received a shock from one of the switches, and as a result of that he had to give up work for 11 weeks. Seeing that the current was at 3,000 volts he did not know how it was that he was not killed. He was all right now. In cross-examination, witness said he had been 12 to 14 years as an electrical fitter,

and knew all about live switches with currents at 3,000 volts, and of their danger. In fact, he was warned about the danger before he began the job in question. The accident occurred on Tuesday, July 20th. On the previous Saturday he started the work. In re-examination, witness said that working with high voltages was very dangerous. He was accustomed to keep his hand off switches, but in the present instance he got it too near. There was no wilful misconduct on his part, and he had not gained anything by doing it. On the contrary, he had lost.

For the defence, Campbell McLean, defendants' foreman, said he had occupied that position for two years. He had been with the defendants for 12 years, doing electrical engineering work. The plaintiff had to attach a copper earth strip to a cubicle which contained switches at 3,000 volts, which was quite enough to kill a man. If he only just touched he might escape as the plaintiff had done. On the Saturday when he told the plaintiff to do the job in question the current was turned off and the cell made dead, because the plaintiff had to go into the cell to do the work. Everything was all right on the Saturday therefore, and it was made so that the plaintiff could not injure himself unless he tried. When the job was finished plaintiff invited him to have a look at it, which he did, and he said that it was all right, with the exception that he was to beat back a bulge into the wall with a hammer. He told the plaintiff to be very careful, as everything was alive on the Tuesday. Plaintiff said he would be. It was necessary for the plaintiff to get near the switches, but not to get inside the cell by any means.

Judge Rentoul asked for a little fuller explanation of what the plaintiff had to do, and later he said he knew that people like the plaintiff took risks which no other men would dream of taking at all.

In cross-examination, Witness said he could not say that it was very silly of the plaintiff to have done what he did, because it depended on whether he had been doing high-tension work. It might be that the plaintiff had only worked where the current was at 500 volts, whereas defendants had 11,000 volts. He specifically told the plaintiff of the danger. It was quite right for the plaintiff to put the bolt in where he did, and it was necessary for it to be screwed up with the nut. Screwing it alone would not take away the bulge, and the hammer was the only thing to use. He thought it was much too dangerous for a man to put his hand within 3 in. of the switch. Witness would not go within 6 in. He did not suggest that the plaintiff put his hand in on purpose. He did not think that was at all likely, or he would be preparing to commit suicide. The job would not have been in working order without the nut attached to the bolt. If he had known the plaintiff was going to do what he did on Tuesday witness would have had the cell isolated.

Thomas Collett, electrical engineer in the defendants' service, said he was in charge of the work in question, and that he warned the plaintiff of the danger of going into one of the cells while it was alive.

Cyril Wilstead, electrical wireman in the service of the defendants, said he heard plaintiff warned of the danger.

Mr. Thomas urged that the plaintiff had backed his opinion against the experience of the defendants' electricians, and so received his damage.

Mr. Duckers pointed out that the onus of proving wilful and serious misconduct was on the employers, and he urged that that had not been done. If there had been a regulation that under no circumstances was the plaintiff to put his hand inside the cell he would have been liable to prosecution for disobedience, and he would have had no case in that Court, but that was not done.

Judge Rentoul said the plaintiff knew on Saturday that the cell was rendered dead, and the motive of that was to make the work safe.

Mr. Duckers urged that men might have accidents of that sort in electrical works however careful they were. The present was an accident for which the employer was responsible under the Workmen's Compensation Act. There was no misconduct on the plaintiff's part, and an accident had arisen out of, and in the course of, the employment. It was necessary for the Court to hold that the plaintiff deliberately ran into the risk, and that he appreciated it, if he was not to recover.

Judge Rentoul: Plaintiff did a dangerous thing thinking it would not be dangerous.

Mr. Duckers: It is not suggested he was trying to commit suicide. Mr. Duckers urged that the accident was touching the wire, but wilful misconduct would be putting his hand in a place where he ought not to have put it. If the Workmen's Compensation Act was of any use to electricians and electrical fitters it would be necessary for the plaintiff to recover.

Judge Rentoul: He was doing what he was desired not to do, putting in this screw; if he had been injured in hammering, having been told to hammer, there would have been no defence.

The Plaintiff was recalled, and said that McLean had evidently got a bad memory.

Judge Rentoul thought there must be judgment for the defendants, and he thought there was serious and wilful misconduct. Consequently it was not necessary for him to go into the other question about scope of employment. He also gave the defendants their costs.

Mr. Duckers said the case was one of very great importance to the electrical world, and the plaintiff, who was supported by his Union, might perhaps wish to take the opinion of the Court of Appeal. If that were done, and if he were successful, he asked that certain medical costs should be allowed.

The Judge concurred.

Mr. Duckers said the plaintiff was a member of his Union, who might decide to support him in his appeal.

Munitions Cases.

At a sitting of the Oldham Munitions Tribunal, last week, Wm. Baron, of Middleton, a turner employed by the B.T.H. Co., Ltd., made a statement of complaint that his certificate had been unreasonably withheld by his employers. He had left the works, as he desired to get back to Oldham, but the firm had refused to give him a certificate. Baron said he would rather be on munitions work at Oldham than at Rugby. Mr. W. Sellars (Chairman) said that was not a reasonable excuse. Baron ought to have made application to the Rugby Munitions Tribunal, and not have left his work until he had got his certificate. Baron said he had been ill, and was not fit to continue. A communication from the B.T.H. Co. was put in, in which the firm stated that they were short of men, and could not see their way to grant the certificate. Mr. Sellars refused to grant a certificate.

In another case at the same Court, Messrs. Ferranti, Ltd., complained that George R. Unsworth, driller, of 83, Lord Lane, Failsworth, had infringed the rule that no person should be the worse for liquor in the establishment, or bring in intoxicating liquor, and another rule that no person should refuse to obey the lawful orders of any person having authority over him. It was stated that the man had attended at the works under the influence of drink. As to the second rule, it was stated that the man was not in a proper state to do his work, and could not obey orders, but the Chairman observed that that would not do, the man not having refused to work. This part of the complaint was then dropped, and, the representative of the firm stating that they did not want a heavy penalty, but would be satisfied with a warning, Unsworth was fined only 5s.

Before the London Munitions Court at Caxton Hall, on October 4th, a workman named Jonathan Peel was, on the complaint of Messrs. Vickers, Ltd., fined £2 for cutting an electric lead connecting a grinding machine, with intent to hinder the progress of certain work.

Phœnix Telephone Co. Fined.

At Bow Street Police Court, on October 8th, the Phœnix Telephone and Electrical Works, Cricklewood Lane, was summoned before Mr. Graham Campbell for unlawfully failing to send in writing to the Public Trustee particulars of shares and stock of the company held by, and for, the benefit of enemies. According to the report of the matter in the *Financial Times*, Mr. Travers Humphreys appeared on behalf of the Director of Public Prosecutions, and said that the proceedings were taken under the Trading with the Enemy Amendment Act. The requirements of the Act were published, and proceedings which had been taken under it at Bow Street Police Court had been published in the newspapers. It would be difficult, therefore, to accept as a defence, or even a plea for the mitigation of a penalty, that companies did not know the law on the subject. The Phœnix Telephone and Electrical Works had a capital of 8,284 preference shares of £1 each and 2,757 ordinary shares of 1s. each. Four shareholders in the company residing in Germany held 1,284 preference shares and 426 ordinary shares. No notice of this was sent to the Public Trustee, but he became aware of the fact through the returns of the company made at Somerset House. When Mr. Oppenheimer, the managing director, was spoken to on the subject, he stated that no dividends had been paid to enemy shareholders, and eventually a full return was made to the Public Trustee. Mr. Travers Humphreys proceeded to state that the case was not put forward as one in which the company or the officials had deliberately desired to conceal from the authorities that they had enemy shareholders. He also wished to point out that although the returns made to Somerset House disclosed the names of enemy shareholders, they did not comply with the Act, the object of which was to enable the Public Trustee to see that no moneys were paid to those persons.

Mr. Walter Frampton, who appeared for the defendants, said that they were now solely occupied in executing Government contracts. Before the war they had purchased certain machinery and materials from Germany, and their customers there had accepted part payment in shares.

The Magistrate said he must impose a substantial penalty as a warning to others, and imposed fines and costs amounting to £185 10s.

Baldock's Telegraph Instruments Co., Ltd., *v.* British Telegraph Instruments Co., Ltd.

In the Chancery Division, on Tuesday, a motion in this matter came before Mr. Justice Sargant.

Mr. Whitmore Richards, on behalf of the plaintiff company, moved for an injunction to restrain the defendant company from presenting a petition to wind up the plaintiff company. In reply to his Lordship, counsel said the defendant company were not represented that day, but a letter had been received from the solicitors for the company suggesting that the motion should be treated as the trial of the action. The solicitors had not, however, instructed counsel.

His Lordship said, on the production of a consent brief on behalf of the defendant company, he would make the *ex parte* injunction which he made on Friday perpetual.

Mr. Richards said the terms of the injunction would be to restrain the defendant company from presenting a petition to wind up the plaintiff company, or from taking any proceedings to wind up the company in respect of an alleged debt of £155.

BUSINESS NOTES.

Bankruptcy Proceedings. — Arthur Faraday Hawdon, of "Yetholm," Elmfield Gardens, Gosforth, Northumberland, electrical engineer.—At Newcastle-on-Tyne Bankruptcy Court on the 7th inst., this bankrupt came up for his first public examination. The statement of affairs showed liabilities expected to rank of £545, and assets estimated at £52. The debtor attributed his failure to Motor Ignitionisms, Ltd., of which he was managing director, going into liquidation. The debtor commenced business in 1905, in Newcastle-on-Tyne, in partnership with another person, under the title of Hawdon, Oliver & Co. The capital amounted to £40 borrowed by the debtor, which had not been paid. The partnership was dissolved in 1907, when debtor paid his partner £20 for his share of the capital, and continued the business under the style Motor Ignitionisms Co. In December, 1909, the company was registered under the style of the Motor Ignitionisms, Ltd., with a nominal capital of £1,000, in £1 shares, which was afterwards increased to £2,000, and the debtor received 500 shares for his business, the company undertaking to pay the trade liabilities but not his private liabilities. In 1913, the debtor and his wife began trading under the style of "A. Faraday Hawdon and Co.," at Newcastle-on-Tyne, without capital, for the purpose of making portable inspection lamps, and in May, 1915, a company was formed named Mico, Ltd., with a nominal capital of £500 in £1 shares, for the purpose of acquiring the business. On February 10th, 1915, £307 was due to debtor from Motor Ignitionisms, and he received £196 on account, and debtor and his wife, who were trading as A. Faraday Hawdon & Co., paid the company £196, which included £165 from machinery and fittings. The hearing was adjourned.

Godfrey, Herbert J., electrical engineer, Tooting.—Trustee released September 23rd.

Catalogues and Lists.—Messrs. Drake & Gorham, Ltd., 1, Felix Street, Westminster Bridge Road, London, S.E.—Two new illustrated and clearly priced pamphlets. No. 237 (14 pp.) brings together most conveniently particulars and prices of Bastian, Belling, Quead, Ferranti, Falco, and Jackson electric fires, also lamp radiators, and the "D.G." electric radiator. No. 236 (16 pp.) is devoted to tungsten and tantalum lamps and lanterns. Prices are tabulated of 11 different makes of one-watt lamps and various designs of lanterns for these lamps, including a new range for smaller-sized lamps; also fittings and lanterns for half-watt lamps; three pages are devoted to Holophane reflectors.

Messrs. F. Husband, Ltd., Craven House, Kingsway, London, W.C.—16-page catalogue of "Quead" electric fires.

Messrs. Johnson & Phillips, Ltd., Charlton, S.E.—16-page illustrated catalogue and price list (section "B") of ironclad switchgear, including "Juno" and "Charlton" fuseboards, "Charlton" and "Victoria" ironclad switches, fuses, fuse elements, accumulator switchboards, tubular hand-grip fuses, "Charlton" bridge fuses, motor-starting panels, fool-proof starting panels, ironclad distribution boards, &c.

Messrs. Belling & Co., Derby Road, Edmonton, N.—The firm have issued a considerable collection of new literature regarding their electric heating specialities. One of the publications is a 40-page illustrated catalogue containing much descriptive information respecting the Belling patent electric fires, many patterns for use in all kinds of places and amid all sorts of surroundings being shown, their prices being stated for various finishes. Several smaller pamphlets, prepared so that contractors and traders can have them over-printed with their own names, deal respectively with the Belling fires for business offices, and for household service as coal and work savers; a desk blotter leaf shows how the "domestic" may be neat and smart, "even at 8 a.m." by using —. The best of the batch, from a pictorial point of view, is a very large advertising poster, executed in appropriate colouring, depicting an Army officer availing himself of the heating properties of a "Belling" in the lighting of a cigar—the purpose of the poster being to catch the eye with the most effective subject of current interest, and to get home with the idea that the electric fire shown is "hot as fire." The sheet forms an effective advertisement, and might be very useful as a cheerful screen for shop windows in these days of restricted lighting. Firms interested can have copies of any or all of these publications on application.

The Edison & Swan United Electric Light Co., Ltd., Ponder's End.—A new catalogue covering a wide range of electric light fittings has been issued, and is referred to in our "New Devices" section to-day.

Argentine Republic: Electrical Imports.—The imports of electrical goods into the Argentine Republic during the six months ending with June last only reached a value of £353,000, as contrasted with £959,000 in the corresponding half of 1914.

Argyll Cars.—A new company has been formed to carry on the manufacture of the Argyll motor-car. The large modern premises of the old company, now in liquidation, have been taken over, and the electric plant will be devoted to specialising in cars for passenger and ordinary work.

Advance in Prices.—The Electric and General Works, Ltd., of 15, Victoria Street, S.W., announce that, in consequence of the increasing cost of manufacture, they have increased the advance on their catalogue prices for switchgear to 20 per cent.

Social.—The engineers of the St. Helens Cable and Rubber Co. held a social at the Royal Oak Hotel, Warrington, a few days ago. Mr. Seymour, the works manager, presided.

Catalogues Wanted.—The Commanding Royal Engineers, York District, as will be seen from our advertising pages to-day, is in want of catalogues of electrical appliances—particularly those relating to lighting.

For Sale.—Messrs. Fuller, Horsey, Sons & Cassell will sell by auction on November 10th, at South Wharf, St. Leonard's Street, Bromley-by-Bow, engineering plant, including a horizontal compound tandem condensing engine, one 30-kw. electric lighting set, a steam pump, a number of three-throw power pumps, conveyors and elevators, winding engines, &c. Particulars are given in our advertisement pages to-day.

Our Trade with China.—Mr. T. M. Ainscough, the Special Commissioner appointed by the Board of Trade to inquire into the conditions and prospects of British Trade in China, has now returned to this country and is prepared to interview (by appointment) representatives of British firms who may be able to see him at the offices of the Commercial Intelligence Branch of the Board of Trade. In order that appointments may be satisfactorily arranged, British firms who may desire to have an interview with Mr. Ainscough are requested to make their application as soon as possible. Such applications should be addressed to the Director, Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Liquidation.—British Drawn Wire Lamp Co., Ltd.—A meeting is called for November 13th, at 59, Chancery Lane, W.C., to hear an account of the winding up.

Trade Announcement. — Mr. M. F. Farrar, electrical engineer, has opened new premises at 14, Crossley Street, Halifax.

"Screwol."—From the Stern Sonneborn Oil Co., Ltd., of Royal London House, Finsbury Square, London, E.C., we have received a leaflet giving particulars regarding their "Screwol" soluble oil. They will be pleased to forward free testing samples of this oil to any of our readers engaged in munition work.

Book Notices.—"Labour Unrest—War-Time Thoughts on a National Danger." By G. E. Toogood. London: A. Brown and Sons, Ltd. 6d. net.

"*Bulletin* de la Société Internationale des Electriciens." No. 45, Vol. V. August, September and October, 1915. Paris: Gauthier-Villars. Price 3 fr.

"Experimental Physics." By H. A. Wilson. Cambridge: University Press. Price 10s. net.

Circular of the Bureau of Standards, No. 55, "Measurements for the Household." Scientific Papers of the Bureau, No. 253, "A Direct-reading Device for use in Computing Characteristics of Vacuum Tungsten Lamps;" No. 254, "A Study of the Quality of Platinum Ware." Washington, U.S.A.: Government Printing Office.

"Elementary Lessons in Electricity and Magnetism." By Prof. Silvanus P. Thompson. London: Macmillan & Co., Ltd. Price 4s. 6d.

"Continuous and Alternating Current Machinery Problems." By W. T. Ryan. London: Chapman & Hall. Price 2s. 6d. net.

LIGHTING AND POWER NOTES.

Argentina.—The public light and power installations belonging to a joint stock company at San Martin (Province of Mendoza) have been sold to Messrs. O. Bromberg & Co., of Buenos Ayres, who will undertake the public service after extending the installation.

The movement recently started in Concordia (Entre Rios) for the formation of a local electric supply company, is materialising rapidly. The proposed capital is $300,000 m/n. Energy for light would be sold at $0.25 and for power at $0.15 per kw.-hour, with a rebate to large consumers. The present price is $0.40 cents.—*Review of the River Plate.*

Banbridge.—Messrs. R. J. Hale & Co., having installed an electric lighting plant, are asking permission of the Urban Council to erect poles and overhead wires or underground cables for supplying premises.

Barrow.—Price Increase.—The Electricity Committee recommends that an addition of 10 per cent. be made to the accounts for the December quarter, and until further notice upon the gross amount charged to private consumers for energy supplied for lighting, heating and power, but as regards consumers whose agreements include a coal clause, credit will be given for any increase resulting from such clause; the increase is not to apply to the Tramway Co., but it will apply to the net amount charged for energy supplied for street lighting.

Blackburn.—Price Increase.—The price of electrical energy is to be increased by 15 per cent, for all purposes.

Bradford.—Bulk Supply.—The Electricity Committee has been informed that the agreement with the Bradford Dyers' Association, Ltd., for bulk supply to Bowling Dye Works will expire in a year's time; that the company did not propose to renew it, but desired to continue a supply on similar terms, but subject to determination by nine calendar months' notice from either party. The Committee agreed to this suggestion.

The Electricity Committee has concluded an agreement with Messrs. Hindle & Firth in regard to a supply of electricity in bulk to their premises at Mill Lane, Bradford.

At the Saltaire Mills a new 1,500-H.P. Westinghouse turbo-generator has been installed, to supersede the several large reciprocating engines previously employed in these works.

Brighton.—Price Increase.—The T.C. has decided to make the following increase in charges for electricity:—Special tariff for arc lamps and advertising signs, 3½d. to 4d.; maximum demand, from 6d. and 3d. to 7d. and 3d.; flat rate from 4½d. to 4¾d.; flat rate to consumers of a minimum of 15,000 units per annum, from 3¼d. to 4d. The charge for hotels, public-houses and piers taking more than 20,000 units per annum, is to be increased by ¼d. on the 1½d. rate, and theatres and other premises taking 20,000 units per annum, by ½d. on the 3d. rate. The flat rate of 5d. per unit for electricity supplied outside the borough is to be increased to 5½d., and for electricity supplied through prepayment meters, by ½d. per unit; the flat rate of 1·1d. for current supplied for power will be increased to 1·25d., and the charge for electricity supplied to the tramways undertaking will be increased from 1·3d. to 1·35d. per unit.

Callan (Co. Kilkenny).—Workhouse Lighting.—The proposal to install electric light in the workhouse has been adjourned for 12 months. The Guardians indicated that they would like to have a statement and estimate from the Electric Lighting Co.

Canada.—The fourth annual report of the Toronto hydro-electric system for the year ended December 31st, 1914, just issued, shows that the operations for the year yielded a gross income of $1,501,291; the cost of electric current, operation and management expenses, including repairs and maintenance, absorbed $874,358, leaving a gross profit on operation account of $626,932; after providing for interest, depreciation and sinking fund amounting to $556,513, there remained a balance of $70,419. Of this sum $69,536 was absorbed by charges and allowances not strictly attributable to the operating account for the year, and by other charges and allowances arising out of transactions of the previous year, the net surplus being $883. The increase in the gross income over that of 1913 was 29½ per cent.; the net increase in consumers connected to the system during the year amounted to over 9,000; the total number of consumers connected at the end of 1914 was over 31,500, and their connected load over 88,000 H.P. A new schedule of rates has been adopted, and came into operation at the commencement of the present year, viz.:—

	Reduced rates. Average per KW.-hour part of 1915.	Old rates. Average per KW.-hr. same period, 1914.	Reduction.
Residence lighting ...	4.00 cents	4.60 cents	13.1 %
Commercial lighting...	2.85 „	3.99 „	28.5 %
Commercial power ...	1.31 „	1.56 „	16.0 %
Street lighting ...	2.12 „	2.49 „	14.9 %

The general manager in his report states that the year has been mainly devoted to consolidating the system and improving the service, together with such extensions as were necessary to deal with the requirements of the immediate future. During the year 5,600 electric irons, among other things, were disposed of, which on the basis of three hours' use a week would mean the sale of 480,000 units per annum, which at the old rates would bring in $13,000. Some 2,400 street lamps were added, making at the end of 1914, an equivalent of 40,800 100-watt lamps. Winter and summer load curves are included, the former showing a maximum momentary peak of 30,430 H.P. and a max. 20 min. peak of 29,020 H.P., and the latter a maximum momentary peak of 19,970 H.P., and a max. 20 min. peak of 18,900 H.P., the winter and summer load factors on the particular days being 68 and 77 per cent. respectively.

Cheltenham.—Annual Report.—The year's working of the Corporation electricity department shows a gross profit of £13,690, as against £14,585 in the previous year; after deducting £10,890 for financial charges there was a net profit of £2,800, as against £3,737. The net profit, added to £294 brought forward from 1913-14, totalled £3,094, from which £2,061 was deducted, being the last full instalment payable on the deficit loan. The balance, £1,043, was carried forward to next year's account.

Cheriton.—Prov. Order.—The B. of T. has granted the Folkestone Electricity Supply Co. an order to supply current to premises at Cheriton.

Continental. — Italy. — The Italian Department of Provincial and Communal Loans for the municipalisation of public services, instituted at the Minister dell'Interno, has sanctioned the redemption by the Communal authorities of the electric light installation at Tirano for a sum of 135,000 lire, and has authorised the commune to contract a loan of 350,000 lire with the Cassa Depositi e Prestiti for the purchase and other expenditure.

Spain.—A company has been formed called the Compania de Energia Electrica de Popayan to supply electricity in the city of Popayan. Water power is available on the Cauca River, from which an open canal brings the water to a point within three miles of the centre of the city; the head is 70 ft. to 80 ft.

Dover.—Annual Estimates.—The working of the electric light undertaking for the year ending March, 1916, owing to the increased cost of fuel (£1,421), and the loss on street lighting (£2,283) is expected to result in a loss of £555, after the payment of interest and sinking fund amounting to £11,788, instead of a surplus balance £2,525, which was obtained last year; the loss is to be taken from the surplus in hand.—*Dover Express.*

Dublin.—Theatre Rates.—The Electricity Supply Committee has recommended the fixing "of a rate of 3½d. per unit net for supply to the regular theatres and music-halls and the offices of the daily newspapers." The capital charges on plant and feeder mains are held to be not properly chargeable in these cases. The picture theatres are excluded from the reduced rate on the ground that a proportion of the plant and feeder mains must be provided for them, since they work during the heavy early evening load.

Dundalk.—Valuation Appeal.—The Court of Quarter Sessions has confirmed the assessor's valuation of the Council's electric light undertaking at £440; the Council submitted that it should be returned at £255.

Ellesmere Port.—Prov. Order.—Messrs. A. J. Leigh and Partners have informed the U.D.C. that they propose to apply for a prov. order for the supply of electricity in the adjoining districts.

Ellon.—New Generating Station.—The site of the generating station (the formal opening of which we reported last week) is that occupied by the gas works, the feu of which was transferred from the T.C. to Duncan's Electricity Supply Co., Ltd. The plant consists of two 68-B.H.P. suction-gas engines, by Messrs. Fielding & Platt; two 42-KW. dynamos, by the British Electric Plant Co.; and a storage battery of 666 ampere-hours capacity, by the Chloride Co. The switchboard was supplied by the Switchgear Construction Co., Ltd. There is at present a total of 1,660 lights in the burgh, and the number is steadily increasing. The whole of the work was carried on under the supervision of Mr. M. K. Cooper, of Messrs. T. C. Smith & Co., Aberdeen. It was expected that the work would have been finished last year, but when the war broke out practically the whole staff of electrical engineers were called up or left on military duty. The new illuminant has given great satisfaction throughout the town.

Farnworth. — The Electricity Committee has been informed that damage had been done to the destructor, presumably from the presence of some kind of explosive in the refuse. It was stated that war badges had been applied for in respect of the chief engineer, assistant engineer, shift engineer, switchboard attendants and mains assistant.

Gillingham (Kent).—Oil Fuel.—The T.C. has asked the advice of the B. of T. as to the purchase of oil fuel for the electricity works. The Anglo-American Oil Co. offers a contract for six or 12 months, at £5 2s. 6d. per ton, ex Purfleet, or £5 11s. 3d. delivered at the works.

Gloucester.—New Industry.—The electrical engineer reported that inquiries had been received from the Gloucester Paper Mills Co. (a new company about to be established in the district), in regard to a large supply of energy for power and lighting purposes (approximately, £5,000 worth a year). The proposed supply would involve very extensive alterations and additions to the existing plant at the electricity works. A Sub-Committee has been appointed to take any preliminary action that may be necessary.

Harrogate.—Year's Working.—For the year ended March 25th, 1915, the revenue of the Corporation electricity undertaking amounted to £18,790, and the gross profit to £8,289. Including other amounts brought in, the balance of net revenue amounted to £8,564, from which, after meeting interest and loan charges, and placing £250 to reserve, the balance of £573 was applied to rate relief. The reserve fund now stands at £2,504. During the year 2,056,731 units were generated, and 1,452,009 sold; the public lamps numbered 825 (incandescent), and the maximum load was 940 KW.

Kettering.—Plant Inspection.—On October 5th the past and present members of the U.D.C. met at the electricity works to inspect the installation generally, and the recent extensions in particular. The new plant has been supplied by the Brush Co. and Messrs. Siemens, and the whole work has cost £8,600. Congratulatory speeches were delivered, the chairman, Mr. Lewis, mentioning that the plant was now in a position to generate over three million units per annum.

Leeds.—Improved Lighting.—As a result of arrangements between the Street Lighting Committee of the Corporation and the chief constable, the streets are to be better lighted than has been the case for some time past, the improvement being gradual until about two-thirds of the street lamps are again brought into use.

Leek.—The Electricity Committee recommends that the charge for lighting churches and chapels be reduced from 5½d. to 5d. per unit, as from July 1st last, subject to an allowance of 10 per cent. on conditions.

London.—Woolwich.—Bulk Supply.—The Finance Committee has been in correspondence with the L.C.C. as to the B.C.'s application for sanction to borrow £4,700 for linking up the undertaking with that of the South Metropolitan Electric Light and Power Co. The sanction is being granted on the understanding that the balance of the loan for plant will be repaid by the B.C. when the plant is no longer in use for the purposes of the undertaking generally, subject to the approval of the B. of T.

Newcastle-under-Lyme.—Exhibition.—An electrical exhibition in premises in the Iron Market, is being held during October by the Corporation.

Oldham.—War Bonus.—The employés at the Corporation electricity and destructor works have agreed to wait B. of T. intervention with regard to a claim of 2s. per week war bonus for all the members of the Municipal Employés' Association.

Pembroke (Co. Dublin).—Plant Extension.—The Council has decided to purchase a new engine in connection with the electric lighting plant of the township, at a cost of £2,000.

Portrush.—B. of T. Sanction.—Intimation has been received by the Urban Council that the B. of T. is now in a position to give its consent to the proposed works for a generating station for electricity supply.

Reading.—Street Lighting.—The Electric Supply Co. has allowed the T.C. a rebate of £84 per annum in respect of the reduced public lighting at Caversham.

Sheerness.—Loan Application.—The L.G.B. has informed the U.D.C. that it cannot at present sanction a loan for the provision of a refuse destructor.

Stockport.—Improved Street Lighting.—The lighting of the streets, which has been subdued for some considerable time, is now to be improved.

Stretford.—Improved Street Lighting.—The D.C. has received an intimation from the County Police that the lighting of the district may now be improved.

Swansea.—Market Lighting.—The Markets Committee has decided to substitute half-watt lamps at the Swansea Market for the present arc lights, which have been causing considerable trouble. The engineer reports that a saving of 25 per cent. would be effected in the consumption of current, and the cost of carboning—£30 per annum—would be done away with. Against this, however, the cost of replacing about once every three years of the burnt-out half-watt lamps would have to be met. The expenditure on the arc lighting (current and carbons) averages £123 per annum at the present time.

In order to economise, the Highways Committee has decided to limit the public lighting of the borough, much of which is by electricity, by lighting only every alternate lamp except where the electric lights are in series, and situate at the junctions of streets.

The Electric Lighting and Tramways Committee was informed that the G.W. and Rhondda-Swansea Railway Companies and the Harbour Trust had granted free wayleaves to enable the Committee to run a cable to the works of the English Crown Spelter Co., but Lord Jersey, through his agent, pressed for the payment of £10 per annum, as it was purely for trade profit purposes. The Committee decided to inform the War Office that the work was being held up owing to the conditions imposed by Lord Jersey.

Trowbridge.—Overhead Wires.—The U.D.C. has decided upon an area in the town in which, as a general principle, no overhead wires are to be used by the Electric Supply Co.

Tunbridge Wells.—Street Lighting.—Owing to restricted lighting the electricity department has allowed a reduction of £1,410 per annum, whilst the regulations are in force, off the public lighting account.

Wilmslow.—The U.D.C. has decided to ask the Alderley Edge and Wilmslow Electric Supply Co. to resume the full lighting of the district at once.

Wolverhampton.—Loan Application.—The Electricity Committee has decided to lay additional mains, &c., at an estimated cost of £1,365, for which L.G.B. sanction is to be asked, as also to the borrowing of £5,000 for defraying expenditure in connection with other mains in the borough. The Committee proposes to renew, for a further period of five years, the agreement for the supply of current to the British Oxygen Co.

TRAMWAY and RAILWAY NOTES.

Australia.—Through the courtesy of Mr. W. G. T. Goodman, chief engineer and manager, we are able to give the following particulars of the working of the Adelaide (S. Aust.) Municipal Tramways Trust for the half-year ended July 31st, 1915. The net revenue during this period was £57,794, and the full statutory charges amounted to £62,390, leaving a deficit of £4,595, but some £2,500 extraordinary revenue expenditure was incurred. The gross revenue for the period was £153,283, or £11,420 less than the corresponding period of last year, and £18,000 less than it should have been had ordinary economic conditions prevailed. The capital cost of the revenue earning portion of the electric traction system, excluding purchase-money and stores, was £1,399,996; the surplus revenue over operating expenses (excluding Port Adelaide horse-car account) was £58,206, and the percentage of working expenses to revenue was 61·9. The surplus revenue over operating expenses equalled 8·3 per cent. on the capital cost. The reserve for renewals now amounts to £87,364, and the insurance reserve to £8,307.

A recent issue of the *Sun* contains some particulars of the new Sydney (N.S.W.) suburban electric railway scheme, for part of which contracts have been made with Messrs. Norton, Griffiths, Ltd. The whole scheme includes a two-track loop-line round, and through, the city, with stations within easy access of all the important business and shipping centres, also an Eastern suburbs railway and a Western suburbs railway. The latter line will pass over the proposed bridge over Darling Harbour to Balmain. The present contract includes the whole of the city railway and parts of the Eastern and Western suburbs railways. It is proposed to provide 160 trains an hour in each direction on the new city railway from the new central station; an ultimate capacity of 192,000 passengers an hour in each direction will be given. A speed of 18 miles an hour, including stops, is proposed, and the round city journey will occupy 10 or 12 minutes. A recent report showed that with the present rate of expansion the suburban railway traffic would double itself in 5·8 years; the city and suburban tramway traffic would double itself in 6·8 years; the Northern suburbs tramway traffic would double itself in 4·9 years; and the ferry traffic in 7 years. Tramway traffic has reached saturation point, and more cars cannot be accommodated at rush hours. It is calculated that the new services would account for 164,000, or 37 per cent., of the through tramway passengers daily, and that 40 per cent. of the tramway cars can be removed from the streets in consequence.

Bradford.—As a result of a conference between the Bingley Council and the Tramways Committee, the latter has agreed to pay an increased price for the current supplied in accordance with Clause 11 of the lease of the Bingley Tramways.

On Thursday, last week, when a Corporation tramcar had mounted nearly to the top of Church Bank—a steep incline where a fatal accident took place some years ago—the vehicle commenced to slip down the hill. Some passengers jumped off the car and received injuries. The car travelled a short distance down the bank before the driver was able to make the brakes work, when it was brought to a standstill, and later it proceeded on its journey.

Bury.—The Tramways Committee has decided that no employé enlisting without the sanction of the head of his department shall receive the benefit of wages during his service with the Forces; it was explained at the T.C. meeting on the 7th inst. that there was no intention to discourage tramway employés from enlisting, but the resolution had become necessary because of the inconvenience caused through motormen staying away and enlisting without giving notice of their intention to do so.

Continental.—Spain.—The concession for an electric tramway from Mongat to Tiana (Barcelona) offered to public competition has been secured by Juan Gari. The line is to be built according to the official plans, and the scale of fares is prescribed.

Cuba.—The Havana Electric Railway, Light and Power Co. has been authorised to construct a new double-track electric tramway in that city. Work must be commenced within a year, and completed within two years, from the date of the promulgation of the decree.

Doncaster.—The Tramways Committee has decided that no unaccompanied parcels be accepted for carriage on the cars, and no fish in boxes, meat in bulk, or fixed perambulators or mail carts; that passengers boarding cars after the first collection of fares has been made on leaving any terminus, and desirous of riding on the top, be asked to pay their fares on the platform before proceeding upstairs.

India.—Electric Vehicle.—According to *Indian Engineering*, there is no reason why small electric vehicles should not displace the rickshaw in hill stations, where these are in general use. Electric vehicles are now on the market that will take most of the gradients found in and about Simla. The overall dimensions of the car need not exceed about 11 ft. × 5 ft., which would be inappreciably larger than the single-seated rickshaw. The conditions on a hill station are ideal for regenerative control, and advantage would naturally be taken of this fact; also the electric braking properties of the motor greatly facilitate matters for hill station use.

Leeds.—War Bonuses.—Application has been made by the tramway employés for extra rates of pay, including time and a half for the seventh day of duty, and for all special or extra duty. It is stated that the previous war bonuses of 2s. and 1s. per week conceded by the Corporation are inadequate to meet the increased cost of living. The General Purposes Committee has declined to accept the contention of the men that the seventh-day work is overtime within the meaning of the agreement as to employment, and considers it would be absurd to submit the point to Sir George Askwith, as desired by the workmen.

London.—On Thursday morning last week, a tramway accident occurred near Finsbury Park, in which from 20 to 30 passengers received injuries. The accident was due to a following car colliding with a stationary car in front, which was discharging passengers, and it considerably interrupted the tramway service.

Liverpool.—Traffic Report.—During the first nine months of the year the economies effected on tramway capital expenditure and in other ways reached £17,000. Over £25,000 worth of free rides were given to members of H.M. Forces and nurses, and war allowances and bonuses were paid at the rate of £40,000 a year. The receipts were £521,546 against £517,240 in the corresponding period last year. The passengers carried had risen from 109 million to 112 million, while the earnings per car-mile had increased by 1·23d.

Manchester.—Track Renewals.—The work of reconstructing the outward track in Portland Street—one of the principal central thoroughfares—has just been commenced.

The Bucklow R.D.C. has decided not to renew the licences granted to the Manchester Corporation tramway department for the running of motor-omnibuses to Northenden, owing to the inadequate service. It appears that the military authorities impressed all the Corporation's motor-'buses. The Corporation received three motor-'buses—it had eight formerly—and ordered more, but the Treasury ban on expenditure made it impossible for it to get the vehicles. It was stated that arrangements had already been made for a "suitable service."

New Zealand.—The Dunedin Council has decided to borrow £26,000 for new tramcars, remodelling the existing cars and for alterations to the approaches to the car-sheds.—*Tenders.*

Oldham.—The tramways manager has been authorised by the Tramways Committee to order parts for renewal of a crossing at Mumps Bridge, at an estimated cost of £400.

Female Labour.—At a meeting of the T.C. last week criticism was offered as to the employment of women as car conductors, and it was suggested that the Tramways Committee could get men suitable for the work. The Mayor said that his wife intended to become a lady car conductor when her year of office was completed, a remark received with laughter.

Rochdale.—War Wages.—The Tramways Committee having considered the application of the tramway workers for a permanent increase of wages in lieu of a war bonus, has decided that it cannot see its way to depart from the decision of the T.C. in the matter.

Southampton.—Electric Tower Wagon.—The Tramways Committee has recommended the purchase of an Edison electric chassis, at £627, for the purpose of a motor tower wagon; also a motor-generator, at an estimated cost of £250, for charging the vehicle, upon the understanding that the Electricity Committee will supply the necessary current at 1d. per unit, the vehicle to be charged off the peak load.

Southport.—Year's Working.—For the year ended March 31st last, the Corporation tramways carried 4,772,478 passengers, an increase of 108,899 on the previous year; the car-mileages for the two years were 475,680 and 463,242 respectively. Despite these increases, the energy used per car-mile decreased from 1·011 to ·977 unit. Working expenses, less war allowances, show a saving of £139, the ratio working expenses to receipts falling from 68·8 to 63 per cent.; the gross profit was £7,312, as against £5,864, and, after meeting war allowances, there was a net profit of £12, the first shown for the past six years. In the previous year there was a deficit of £1,403. The improved returns are attributed to the opening of the "Grand Tour" section, on which the receipts averaged 29·4d. per car-mile, despite the interference of the war. The reserve and renewals fund is stated to be £442 for the Corporation worked lines. Certain lines in the borough are leased to a company, and the balance of receipts from those lines is shown as £15,804; up to the same date there was a total deficit on the Corporation worked lines of £9,472, and, taking both concerns, there is a balance shown of £6,332.

Walsall.—The Birmingham and Midland Tramways Joint Committee is to be asked for the reason of the failure of current on the Wednesbury and Willenhall lines on four occasions recently, when the tramway traffic was suspended for some hours. The tramway manager reports that the introduction of female labour on the cars has been successful, and that, at present, 18 women are engaged as conductors. Messrs. W. A. Stevens, Ltd., state that, in consequence of Government orders connected with the war, they could not give any date for the delivery of the three motor-omnibuses remaining to be delivered under their contract, and that they could not give an unconditional guarantee of delivery of the three additional 'buses for which the Committee contemplated giving them an order. Under the circumstances, the Tramways Committee has decided not to place a further order with the company at present, and, in view of the urgent necessity for additional travelling facilities to be provided, recommends that it be authorised to purchase three 'buses, at a total cost not exceeding £3,000. In this connection the town clerk has been instructed to write to the War Office, the Admiralty, and the Ministry of Munitions, requesting that, in view of the necessity for further travelling facilities being provided for the adjoining colliery districts, they will allow the contractors to deliver the motor-'buses ordered, or to be ordered, on behalf of the Corporation, so that an adequate service can be given to such districts. The Committee is prepared to make a contribution of £2,000 in aid of rates, out of the profits of the undertaking, for the year ending December 31st next.

TELEGRAPH and TELEPHONE NOTES.

Australia.—A revised scale of charges for telephone services has been laid before the House of Representatives by the Postmaster-General; it practically doubles the present rates for effective calls, both on subscribers' instruments and public telephones, while the ground rents are to be imposed on a basis which, in some individual cases, will involve a slight reduction, and in others a slight increase. The line covered by ground rent is in each case miles. The revised scale for ground rent is as follows:—

Subscribers' lines connected.	Radius of network.	For an exclusive service.	For each subscriber or instrument on a two-party service.	For each subscriber or instrument on a three or more party service.
Exchanges or networks having—	Mls	£ s. d.	£ s. d	£ s. d.
From 1 to 300...	5	3 0 0	2 10 0	2 0 0
„ 301 to 600	5	3 5 0	2 10 0	2 0 0
„ 601 to 1,500	5	3 10 0	2 15 0	2 5 0
„ 1,501 to 4,000	10	3 15 0	3 0 0	2 10 0
„ 4,001 and upwards ...	10	4 0 0	3 0 0	2 10 0

Charge for Calls.

For each effective call originating from a subscriber's instrument, 1d.

For calls originating from a public telephone, 2d. per conversation of three minutes.

In future the ground-rents will vary according to the number of subscribers' lines, instead of being based on a population basis as at present. In the aggregate the department will lose about £1,000 by the change. The population basis has proved to be unfair. Existing contracts will be allowed to run their course, but the rentals on the new basis will apply immediately to all new subscribers. The increased rates will come into operation about the New Year.

In submitting the new scale, Mr. Spence also tabled the report of the Departmental Committee of Investigation which met last year to inquire into the best means of meeting the deficiency on telephone working, which amounted to £296,424 for the year ended June, 1914. The Committee found that a saving of £78,000 per annum could be effected by economies in operating and repairs and maintenance. To make up the remaining deficiency of £218,000, the Committee recommended the adoption of an amended scale.

Chorley.—The B. of G. has decided to install the Dictograph-Turner intercommunication telephone system in the workhouse, at an estimated cost of £140. Tenders are to be invited for the work.

Japan.—According to a report just to hand, although there is a very active demand for connections to the telephone system in Tokio, only one-tenth of the recent applications have been attended to, the Central Telephone Bureau not having sufficient available funds. It is also stated that the telephone apparatus in use is quite out of date, and not to be compared with that employed in Europe and America. The authorities are fully aware of this, but cannot do anything to improve matters; owing to the shortage of allotted appropriations and the rigorous curtailment in expenditure enforced in all the Japanese Government Departments.

New Lines.—The Compagnie Française des Câbles Télégraphiques has opened for traffic a submarine cable between San Domingo and Mayagnez in Puerto Rico, connected by an overland line 186 km. in length with San Juan.—*Journal Télégraphique.*

New Telephone.—It is reported from Christiania that a new micro-telephone (? microphone) has been devised by a Norwegian inventor, which renders it possible to telephone to a distance three times greater than at present, and that the invention is also of considerable importance for wireless telephony. The sum of £25,000 has been set apart for carrying out official experiments, which are to begin shortly.

Norway.—The construction of the trans-Atlantic radio-telegraph station at Stavanger, Norway, which has been delayed by the war, has been resumed by the Marconi Co. When completed Stavanger will exchange traffic with the Marconi station at Chatham, Mass.—*T. and T. Age.*

Spain.—The installation of a telephone system connecting the various towns of the four united Provinces of Catalonia, including the establishment of central telephone exchanges, has been authorised.—*Board of Trade Journal.*

Telephoning in French.—The French language is said to have been found much better adapted to long-distance telephoning than the English, and operators in Paris have succeeded in transmitting messages to London at the rate of 190 words a minute.—*T. and T. Age.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—December 7th. P.M.G.'s Department (various States). Non-encrusting zincs, carbon and manganese powder, manganese chloride, chloride of ammonia, porous pots (2 in.), outer jars for cells, carbon blocks, resistance boxes of 5,000 ohms, &c. See "Official Notices" to-day.

Sydney.—December 6th. Municipal Council. 33,000-volt outdoor transformers and switchgear. Specifications (10s. 6d.) from Electric Light Department, Town Hall.

December 20th. Metropolitan Board of Water Supply and Sewerage. Centrifugal pumps and electric motors at the Marrickville low-level pumping station.

November 4th.—P.M.G. 58 miles lead-covered cable (11 items).

January 12th, 1916. N.S.W. Railway and Tramway Department. Two water-tube boilers, &c., for the Zara Street power house, Newcastle. See our last issue for further particulars.

January 31st, 1916. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust, Circular Quay.

Melbourne.—December 14th. Deputy P.M.G. Eleven sections of a lamp-signalling trunk-line switchboard, and other material necessary for increasing the equipment of Melbourne trunk exchange from 108 to 240 lines. Schedule 1,207.*

Victoria.—December 14th. P.M.G. For delivery in all States, 18 670 common-battery wall pattern telephones, manufactured in Australia. Sched. No. 1,264.

Victorian Railways.—January 5th, 1916. Installation of automatic sprinklers and thermostats at Jolimont car-shed. Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Perth.—December 8th. 294 accumulators, and power board complete, for P.M.G.'s Dept. See "Official Notices" October 8th.

Goulburn.—October 30th. One 200-kw. direct-coupled d.c. generating set, gas or steam driven. Specification (10s.) from the Town Clerk, or at the office of the Local Government Association, 103-4, Queen Victoria Markets, Goulburn.

Darlington.—October 22nd. Corporation. 3,000-kw. turbo-alternator; surface condensing plant. See "Official Notices" October 8th.

Dublin.—October 25th. Corporation. Alterations and additions to electric lighting of public baths and wash-houses, Tara Street. Specifications from the City Electrical Engineer, Fleet St.

November 4th. Great Northern Railway Co. (Ireland). Twelve months' supply of stores, including a number of electrical items. See "Official Notices" to-day.

Dundee.—October 21st. The Harbour Trust. Electric lighting of Shed "Y" at the new wharf. Specifications, &c., from Mr. J. H. Thompson, General Manager and Engineer.

Greystones (Co. Wicklow).—One 60-b.h.p. gas engine, alternator, and switchboard panel for Greystones Electric Light and Power Co. See "Official Notices" October 1st.

Leeds.—October 18th. Overground transformer chamber at Houghton Street and Rawson Place, Dewsbury Road. C. N. Hefford, Manager, Electric Lighting Department, 1, Whitehall Rd.

Littleborough.—October 22nd. U.D.C. h.t. cables, road-work, &c., transformers and switchgear for sub-station. See "Official Notices" October 1st.

New Zealand.—Dunedin.—November 3rd. City Council. Insulated and bare copper wire for a period of two years.*

November 3rd. City Council. One 3,000-volt regulator.*

Salford.—October 18th. Coal required for the electricity department. Particulars from the Borough Electrical Engineer, Frederick Road, Pendleton.

Spain.—October 30th. The municipal authorities of Avila are inviting tenders for the concession for the electric lighting of the town during a period of ten years.

Watford.—October 18th. Wiring new waterworks pumping station for light and power, for the U.D.C. Mr. D. Waterhouse, Engineer, High Street. (Returnable deposit of £1.)

York.—October 28th. N.E. Railway. Six or twelve months' supply of telegraphic apparatus, wire, and line stores. See "Official Notices" to-day.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Argentina.—The tender of the Anglo-Argentine General Electric Co., Ltd., for the supply of 40,000 carbons for the lighting of the port of La Plata has been accepted by the Direccion General del Puerto de Buenos Aires; price $4,475 m/a.

Australia.—Tasmania.—The tender of the B.I. and Helsby Cables, Ltd., has been accepted by the Launceston City Council for the supply of 2,640 yards of underground armoured feeder cables, at £1,082, subject to the market price of copper and lead.

Sydney.—The following contracts have been received by the Municipal Council:—

D.C. Two-wire Meters.

Noyes Bros. (recommended)	£2,920
Standard Waygood-Hercules, Ltd.	2,938
Haes & Eggers	3,743
Edison & Swan	4,049
Aust. General Electric Co.	5,747

A.C. Two-wire Meters.

Standard Waygood-Hercules, Ltd.	£6,830
Haes & Eggers	7,028
Noyes Bros. (recommended)	7,145
Laurence & Hanson	7,176
Edison & Swan	7,699
Aust. General Electric Co.	8,068

Turbine Platform, No. 12 Turbine.

Poole & Steel (recommended)	£298
Sydney Steel Co.	319
Luke Muras	340
R. L. Scrutton & Co.	365

Motor or Rotary Converter.

	2,000-kw. set.	Price per kw. of output.
Brit. Westinghouse Co. (recommended)	£7,347	£3·469
Guthridge, Ltd.	8,487	4·89
Dick, Kerr & Co.	9,364	4·432
Siemens Bros.	9,780	4·890
Aust. General Electric Co.	10,199	5 099

Oil Dryer and Filter.

Aust. General Electric Co. (recommended)	£368

The following tenders have been accepted:—

Victorian Railways.

Electric lighting material for the Jolimont car shop, £237.—W. T. Henley's Telegraph Works Co., Ltd.

Electrical equipment for new bogie cars, Brighton street railway.—Aust. General Electric Co.

N.S.W. Public Works Department.

Installation of six electric goods-lifts at the State abattoirs, Homebush £2,935.—Standard Waygood-Hercules, Ltd.

Emu Bay Municipal Council (Tas.).

Electric lighting plant, £2,284.—Dalgety & Co. —*Tenders.*

Bradford.—The city engineer having reported that the North-Eastern Steel Co., Ltd., had rolled about 45 tons of steel tram rails in excess of the quantity required by the Corporation under their contract, and that the surplus rails were now offered at the price of £6 per ton, it has been decided to recommend the City Council to accept this offer.

At a recent meeting of the Works Sub-Committee, the general manager submitted correspondence which had passed between himself, the War Trade Department, and the Board of Trade, with respect to the contract placed by the Corporation with Messrs. Brown, Boveri & Co., Ltd., for the supply of tramcar motors. He further reported that, as a result of small modifications in detail of the motors, the original contract price of £22,000 would be increased to £22,318, and the Sub-Committee decided to recommend that the increased price be approved.

The Tramway Works Sub-Committee has accepted the offer of the British Oxygen Co., Ltd, for the supply of oxygen required by the Tramways Department during the ensuing three months at the price of 35s. per 1,000 cb. ft. It has also accepted the tender of Messrs. Scholey & Co., Ltd., for gear wheels and pinions for car motors as follows: 200 tool-steel gears, at £7 9s. each, and 200 tool-steel pinions, at £1 5s. each.

Dartford.—The electrical engineer has been instructed to order 100 tons of South Leicester nuts from Messrs. J. Waddell and Sons, at 24s. per ton delivered, and, if it proves satisfactory, a further 400 tons. The offer of Messrs. John Hudson & Co., Ltd, of about 180 tons of South Hetton coal, at 26s. 9d. per ton delivered, has been accepted.

Edinburgh.—The Council has accepted tenders by Messrs. Fraser & Chalmers for turbo-alternators and condensing plant for the Portobello new power station. Messrs. Vickers and Messrs. Richardsons, Westgarth & Co., are sub-contractors. A discussion that took place respecting the matter is reported in our "War Items" to-day.

Hereford.—The T.C. has accepted the tender of Messrs. Bowater, of Birmingham, for 1,000 tons of Haunchwood fine slack coal for the electricity works.

London.—L.C.C.—The Highways Committee recommends that the operation of standing order No. 295 be suspended, in order that payment may be made to the following firms for work done at the Greenwich generating station:—Messrs. J. Cochrane & Sons, Ltd., retention money under their contract for the laying of condensing water pipes; payment on account of £3,127 to Messrs. Davidson & Co., Ltd., in respect of their contract for the provision of four induced draught fans; a further payment on account of £4,885 to the British Westinghouse Electric and Manufacturing Co., Ltd., in respect of their contract for the supply of high-tension switchgear, &c.

Rotherham.—The Tramways Committee of the T.C. has arranged to purchase three motor-omnibuses from the Daimler Co., Ltd., at £953 10s. each.

Southampton.—In reference to the Electricity Committee's contract with the British Thomson-Houston Co., for the supply of a rotary converter, the British Electric Transformer Co., who are sub-contractors to the British Thomson-Houston Co., have notified them that their original price of £496 for the necessary high-tension transformers would not hold good owing to the increased cost of materials, &c. Under the circumstances the Committee has agreed to the amount of the contract being advanced to £542. The Committee has had its attention drawn to the necessity of providing slot meters, but has deferred consideration of the matter in view of the difficulty of obtaining meters at the present time.

The T.C. received the following tenders for installing electric light at the Ascupart Street Police Station :—

A. Kingman & Co.	(accepted)	£18 12 0
J. Davis & Co., Ltd.		19 10 0
F. W. Cook & Co.		21 11 6

The tender of Messrs. Edgar Allan & Co. has also been accepted, at £225, for tramway points and crossings. Messrs. Hadfield's Steel Foundry, Ltd., quoted £240.

The offer of Mr. H. P. Pemberton to purchase a quantity of old rails, at 87s. per ton, has been accepted.

Torquay.—The Electricity Committee has accepted the offer of Messrs. Cory Bros. to supply 1,500 tons of coal in equal quantities extending over a period of 12 months, subject to their giving the Council the benefit of any rebate allowed them from the collieries in consequence of Government legislation for limitation of prices.

Watford.—The Electricity Committee has accepted the offer of Messrs. W. Cory & Son, Ltd., to supply 900 tons of Arley peas coal, at 19s. 7d. per ton.

Wolverhampton.—The Electricity Committtte recommends the acceptance of the tender of Messrs. Amies & Sharratt, at £1,045, for constructing the foundation and other work in connection with the new cooling tower.

Woolwich.—The following tenders have been accepted by the Electricity Committee in connection with the extension of the Globe Lane Station :—

S. B. Goslin & Sons.—C.I. chute plates, £23.
Bell's Asbestos Co.—Covering 8 in. and 8 in. steam pipe for 3,000-kw. turbo-alternator, £39.
Ferranti Ltd.—Switchgear for 1,000-kw. converter, £120.

The borough electrical engineer has been instructed to purchase either a new or secondhand centrifugal pump to be installed at Globe Lane Works, so that the various turbines may be run in parallel without risk of losing the circulating water. By the adoption of this pump a larger output can be handled with greater safety. The Royal Arsenal authorities have accepted the Committee's quotation for a permanent supply to the Dockyard, and in this connection a contract is to be sealed with Messrs. Ferranti Ltd., for the supply of the necessary switchgear at a cost of £101.

FORTHCOMING EVENTS.

Institution of Mechanical Engineers.—Friday, October 15th. At 8 p.m. At the Institution of Civil Engineers, Great George Street, S.W. Paper on "The Theory of Grinding, with Reference to the Selection of Speeds in Plain and Internal Work," by Mr. J. J. Guest.

Greenock Electrical Society.—Friday, October 15th. Lecture by Mr. F. H. Whysall (Hon. President), chief electrical engineer, Greenock, on "The Construction of Storage Batteries." Mr. A. Norwell, B.Sc., Principal of Greenock Technical School, will preside.

The Faraday Society.—Tuesday, October 19th. At 8 p.m. At the Institution of Electrical Engineers. General Discussionion "The Transformations of Pure Iron." Sir Robert Hadfield will preside. Dr. A. E. Oxley, of the University of Sheffield, will open the Discussion. Tickets may be obtained from the Secretary, at 82, Victoria Street, S.W.

Diesel Engine Users' Association.—Wednesday, October 20th. Further Discussion on "Lubrication of Diesel Engines."

Nottingham Society of Engineers.—Wednesday, October 20th. At 7.30 p.m. At Welbeck Hotel, Milton Street. Paper on "Steam Turbines, Blowers and Compressors," by Mr. J. Goldes.

Chemical Society.—Thursday, October 21st. At 8 p.m. At Burlington House, W. Informal Meeting.

Junior Institution of Engineers.—Friday, October 22nd. At 8 p.m. At 39, Victoria Street. Paper on "Safety Precautions for Transmission Machinery," by Mr. W. V. H. Capps.

Manchester Association of Engineers.—Saturday, October 23rd. At Grand Hotel, Aytoun Street. Paper on "Notes on Some Recent Researches," by Prof. J. E. Petavel.

NOTES.

Lamp-Trimmer's Ladder.—The street lamps in Chicago are trimmed from a ladder which is set firmly against the base of the post on which the trimmer is working, while the ladder leans outwards and is supported from the post at its upper end by an iron stirrup, which maintains it at a convenient distance from the lamp globes. The trimmer, while ascending the ladder and while working on the lamps, remains at all times between the ladder and the post. Such a ladder possesses several advantages over the ordinary ladder. It is, for example, impossible for it to slip; it presents practically no obstruction to pedestrian traffic; it places the trimmer in a convenient position for working, and it minimises the hazard to both the public and the trimmer.—*Electrical World.*

Foreign Trade.—Figures for September.—The following are the electrical and machinery figures given in the official returns for September :—

	Month of September.		*Inc. or dec.*	*Nine months, 1915.*		*Inc. or dec.*
Imports.	£		£	£		£
Electrical goods and apparatus, excluding machinery and uninsulated wire	107,369	+	59,599	766,128	−	263,084
Machinery ...	805,587	+	583,889	6,873,390	+	1,566,117
Exports.						
Electrical goods and apparatus, excluding machinery and uninsulated wire	262,088	+	82,015	2,270,267	−	114,123
Machinery ...	1,611,450	−	12,600	14,611,354	−	11,495,212

Radium and Plant Growth.—As the result of very careful experiments, the conclusion has been reached that radio-active materials exert no appreciable influence on the growth of plants, in spite of the favourable results that were announced some time ago.

Spanish Prize Competition.—The Spanish Society for promoting the national industries, styled El Fomento del Trabajo Nacional, announces that the Deu annual premium of 5,000 pesetas will be awarded this year for any new invention, process, or improvement in the department of electrical or mechanical engineering, chemistry, physics, the arts, or commerce, tending to the progress of Spanish industries. The competition is open to foreigners, and further particulars may be obtained from the Secretaria, 4, Plaza Santa Ana, Madrid.

Removing Russian Electrical Plant.—It was reported at a recent meeting of the Electrotechnical Section of the Russian Military Industries Committee, that much of the electrical machinery and apparatus removed from places ordered by the military authorities to be evacuated had been removed by wholly incompetent people. Many comparatively useless parts had been taken, and essential parts left behind. It is stated that to obviate such errors in future, the Military Industries Committee will be charged with the execution of the work.

The A.S.E.—It is announced that the Amalgamated Society of Engineers has, by 16,075 votes to 14,259, resolved to secede from the General Federation of Trade Unions. The *Times* reports Mr. Young, the general secretary, as saying that the members no longer wish to belong to a financial federation, but to build up a fund of their own.

Volunteer Notes.—Engineering Institutions' Volunteer Training Corps.—

Company Orders.—By Lieut.-Col. C. B. Clay, V.D., Commandant, for week commencing October 18th, 1915 :—

Drills, 6.15 to 7.15; 7.15 to 8.15 p.m.

Monday, October 18th.—Section 1, Technical; Section 4, Squad.

Tuesday, October 19th.—Section 2, Technical; Section 3, Shooting.

Thursday, October 21st.—Section 3, Technical; Section 2, Shooting.

Friday, October 22nd.—Section 4, Technical; Section 1, Squad.

Signalling Class Mondays and Fridays, but members will attend Technical Classes Mondays and Fridays with their Sections. Recruits attend on Mondays and Fridays.

Members will fall in for all Drills at the new Headquarters, Chester House, Eccleston Place, S.W., on and after Monday, October 18th.

E. G. Fleming,
Company Commander and Acting Adjutant.

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, October 14th, 1915 :—

Week-end Parades.—Saturday.—Field Day. The Battalion will parade at Baker Street Station at 2.15 sharp, and proceed by train, right half Battalion, under the command of Mr. H. O. King, to Neasden Station; left half Battalion, under the command of Mr. W. Ridd, to Preston Road Station. The general idea has been issued to the Commanders concerned.

Sunday.—The Battalion will parade at Liverpool Street Station at 9.30 a.m. and proceed by train, for entrenching duties, returning about 4.55 p.m. The Quartermaster will make the necessary arrangements for lunch and refreshments.

Entrenching.—Members are reminded that this work is still being carried on daily (except Fridays), and are directed to attend as frequently as possible.

Musketry.—Saturday next, the 16th inst. There will be shooting at both Acton and Bisley Ranges, as usual. Members proceeding to Bisley must report themselves to Sergeant Cotter, at the barrier of No. 9 Platform, Waterloo Station, at 12.45 p.m.

Tuesday next, the 19th inst. Shooting at Acton, as usual.

A. G. Joiner, *Major and Adjutant*, O.B.C.

A 500-mile Electric-Vehicle Run.—Recently Mr. Chas. Chamberlain, of Buffalo, N.Y., made a journey across State from Buffalo to New York, in a Waverley electric car. The trip would have been completed in three days but for poor charging facilities in two places which delayed matters. To cover the 504 miles, 94 kw.-hours were required, or 18 kw.-hour per mile.

The Electro-Harmonic Society.—The first smoking concert of the season was held on Friday evening last at the Holborn Restaurant. Notwithstanding the prevailing war conditions there was a large company present. The well-filled concert hall bore evidence that the value of a few hours' fraternisation and relaxation among kindred spirits is clearly recognised in these days when electrical men, like other engineers, are feeling the strain of munition-making and other war activities and anxieties. The artistes were all good—several specially so. Encores were frequent, and the applause was both enthusiastic and unstinted. Altogether the opening night augured well for a successful season. Mr. W. J. Tennant made a capital chairman, and as his remarks are, in our estimation, worthy of a wider circulation than they obtained last Friday, we quote them below :—

"Gentlemen, the next turn is my turn. Your secretary—you know what a martinet he is—has asked me to say a few words. First, I have to express regret that our hon. treasurer, Sir John Snell, who was to have taken the chair this evening, at the last moment found himself unable to do so. As you all know, his official responsibilities have recently been much increased, and he writes that he is driven from pillar to post, and is being shamefully overworked. Then our old friend and musical director, Mr. Gatehouse, writes that he is recovering from a slight attack of bronchitis. He says the programme has purposely been made a little shorter than usual on account of the difficulty of getting home these times. You have to grope your way owing to the increased darkness of the streets, and there are also the difficulties of reduced train facilities and other means of locomotion to contend with. Members may, therefore, be glad of the opportunity of leaving somewhat earlier than has been the case in previous years. Now I have a few statistics which I should like to bring to your notice. The number of members on the roll at the end of last season was 632 as compared with 664 at the end of the previous season. Since the end of last season two have died, 21 have resigned outright, and 36 memberships are in abeyance till the end of the war, either on account of absence on active service or because of bad times. This is somewhat serious, as the result is that our active membership is reduced to 573, and, furthermore, only 13 new members have been put up for election so far this season, as compared with 55 last year. Last, but not least, current subscriptions are not coming in as well as they might, and certainly not as well as usual, or as they ought to do. In these unprecedented times, I think we should make a special effort to keep things going and to carry on as usual. Is it to be said, when the war is over, that we had not the nerve or the cash to keep the Electro-Harmonic Society going in spite of the 'Bosches?' That these are days for economy, I agree; but there are wise and unwise economies, and I think this is essentially a time when a sane and reasonable amount of recreation should be taken, especially when it does not run us into much expense. The concerts we get at the Electro-Harmonic Society are half the price of, and far superior to, those usually provided for this class of entertainment; and there is a camaraderie existing amongst us that is not to be found amongst ordinary audiences. I suggest that we should all put our shoulders to the wheel, and determine to keep the flag of the Electro-Harmonic flying bravely until the better times arrive that we must all hope are in store for us in the future. Remember the 'Ladies' Nights,' and bring the ladies on those occasions just the same as usual. The ladies are doing a great deal for us in these days, and we should show our gratitude to them in every possible way."

Workman Fined.—Frank Taylor, iron turner, of Ann Street, Stockport, was summoned at the Stockport Police Court, on Tuesday, by his employers, Messrs. G. H. Heywood & Co., Ltd., electric power engineers, of Reddish, for breach of contract in unlawfully absenting himself from work. It was stated by Sir William Cobbett (for the firm) that between September 4th and September 28th defendant absented himself from work, more or less, on 12 days, and was away for just short of 50 hours. Defendant worked on a lathe, and his action in absenting himself rendered other workmen, and machines also, idle, with consequent loss to the firm, who were engaged in important Government work. The firm claimed £5 from defendant. Taylor told the Bench that he did the heaviest work in the shop, and he complained that there were two motors behind him, and he felt a draught. He was ordered to pay the £5 claimed, together with the costs of the proceedings.

Institution and Lecture Notes. — Institution of Heating and Ventilating Engineers.—At the autumnal general meeting held on Tuesday last at the Holborn Restaurant, Mr. W. Jones read a paper on "Heat Transmission and Heat Emission," and Mr. S. Naylor read one on "A Comparison between Forced Firing and Slow Combustion."

University of London.—Prof. J. A. Fleming is to deliver a course of six lectures on "Electric Heating and Electric Furnaces," at the University College, on Friday evenings, at 5 p.m., beginning on October 29th. The fee will be £1 11s. 6d. for the course.

Electrical Association of Australia.—The first meeting of the Federal Council was held in Melbourne on August 16th, 17th and 19th. Those present included New South Wales councillors Mr. O. W. Brain (Federal president), Mr. H. W. Myers (president New South Wales section), and Mr. A. C. F. Webb. The latter also acted as substitute for Mr. H. R. Forbes Mackay, who was unable to be present. The Victorian councillors were Mr. W. H. Alabaster (president of the Victorian section), Prof. Payne, and Mr. W. J. Newbigin. Mr. Newbigin was appointed hon. Federal secretary. A number of matters pertaining to the Association were discussed. A draft of the proposed rules governing the work of the Federal Council was submitted and approved, and a number of applications for membership were dealt with and approved prior to their election by the respective sections.

At the August meeting of the N.S.W. Section a paper on "Direct-Current and Alternating-Current Sub-Stations" was read by Mr. J. S. Just.

Association of Mining Electrical Engineers.—It was reported at the opening meeting of the session of the West of Scotland Branch that the membership now stood at 201. The Chairman (Mr. A. B. Muirhead) in explaining the work for the ensuing session, specially referred to a series of coal-cutting demonstrations which had been arranged through the kindness of Mr. Arnott, of the United Collieries, and Mr. J. P. C. Kivlen, of the Brodisholm Colliery. Mr. Muirhead delivered an address on "The Development of Electricity in the Scottish Mining Industry," in which he pointed out that they had now got sufficiently far from 1911—when the present code of electrical rules applicable to mining came into operation—and sufficiently near 1920 (when plant installed under the code of 1904 must be removed from active service to comply with statutory regulations) to justify a *résumé* of the whole position. Scotland's mining output had doubled in 30 years, and the mining conditions were hard and uncompromising. These difficulties had not always been understood by the legislators south of the border, who seemed to think it fitting to make laws as if Britain had one colliery of one coal seam and one set of conditions. Those difficulties in mining had led to a most marked development in the use of electricity for power purposes below and above ground, and he submitted tables to show that in all approximately 137,200 E.H.P. in motors had been installed, and taking this at 340 out of a total of 547 collieries, they had an average of 403·5 E.H.P. per colliery. The number of electrically-operated coal-cutting machines in use, which reached a total of 747, showed to what extent electricity had been called upon for "in-bye" purposes in the Scottish mine field. The number of compressed-air coal-cutters in use and their output per year did not appear to indicate that that type of machine need be seriously considered as a rival to the electrical machine as they now knew it.

Inquiries.—A correspondent asks for information as to the electrical uses of "Manjak."

Kharkoff Electric Supply System.—The *Electritchestvo* gives a full illustrated account of the Kharkoff electrical plant and equipment, which have undergone a series of extensions; further additions are again called for. The old town electric station was inaugurated in 1897, with four steam generators of a total capacity of 150 × 4 = 600 I.H.P., and an accumulator battery. Extensions of the plant took place in 1900, 1904 and 1906. In the year 1909 the total output was 2,927,212 KW.-hours. The street lighting was entirely effected by means of arc lamps, of which there were 530 in 1910. The demand has always been ahead of the capacity of the station. The town tramways began operation in 1906. In 1910 it was recognised that the station was inefficient in respect of pressure, accommodation and plant, and the construction of a new station, with alternating high-pressure (6,000 volts) current, was proceeded with, this station being inaugurated in 1912. It was built on very bad ground, and special measures had to be taken to complete the construction within the agreed time. The buildings and lines are planned to reach their maximum in the winter of 1915-16. Down to 1/14 January, 1914, the money spent on all the work was about 1,200,000 roubles, besides bonds to the value of 500,000 roubles. There are about 35 versts of tramway, of metre gauge, employing about 800 workpeople.

New 7-cwt. Edison Electric Vehicle.—A new electric delivery vehicle built to Mr. Edison's designs and intended for loads up to 7 cwt. has just been publicly displayed at the Edison works at West Orange, New Jersey, U.S.A. According to a statement by Mr. Edison, the object of the car is to replace the horse-drawn delivery van of the small tradesman, and he claims that the cost of upkeep and running, including energy and storage, will equal only half the cost of feeding and stabling a horse, while the cost of tires will be less than that of shoeing a horse. The new vehicle is fitted with an Edison battery of a capacity sufficient for a range of travel of 45 miles on one charge, at a speed of 10 miles per hour.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—MR. A. F. BOND, shift engineer at the Hornsey Corporation electricity works, has been granted a commission in the Royal Field Artillery. Mr. Bond has already seen service at the front in the 6th London Regiment, having been sent home wounded last May.

The Woolwich B.C. has increased the salaries of the following officers in the electricity department:—Mr. C. G. ELEY, leading charge engineer, from £150 to a maximum of £180; Messrs. T. W. BUNCE, L. G. BUTLER, and C. HOBSON, charge engineers, from £140 to a maximum of £170 by two annual increments of £15 per annum. Mr. W. SCOTT, at present acting charge engineer, is to be designated "charge engineer,"

and his salary increased from £130 to £140 per annum, rising to a maximum of £170 by two annual increments of £15.

Mr. W. Leighton Chubb has been appointed station superintendent at the Maidenhead Corporation electricity works.

Mr. F. Hayward and Mr. Poole, of the staff at the Hereford Corporation electricity works, have resigned. The former has taken up munitions work at the Coventry Ordnance Works.

Mr. H. A. Neville, the Wakefield City Electrical Engineer, has received permission from the Electricity Committee to accept the post of Secretary to the Wakefield Munitions Committee.

Mr. Archd. J. S. Waddell has resigned his position of shift engineer under the West Bromwich Corporation, having been appointed to a similar position at the Nechells power house under the Birmingham Corporation.

Mr. Herbert Broadbent, engineer and manager of the electricity department of Perth, Western Australia, resigned his post at the end of July, and has returned home in order to assist in the manufacture of munitions, or otherwise to take part in war work. Before leaving Perth he was presented with many souvenirs by societies with which he had been connected for many years, and at a farewell meeting of councillors and municipal officials held in his honour, the Mayor pointed out that Mr. Broadbent went to Perth in 1896, to erect the first electrical plant of any size in the State, for the Gas Co.; under his guidance the electricity department had been exceedingly successful, and was acquired by the city in 1912 on very generous terms, Mr. Broadbent continuing in office as engineer and manager. The Mayor expressed regret at his departure to place his services at the disposal of the home authorities, and wished him the best of fortune; the ex-mayor and the chairman of the lighting committee supported the Mayor, and Mr. Broadbent expressed his appreciation of the goodwill shown towards him.

Captain G. C. Milnes, borough electrical engineer for Lancaster, has been appointed Adjutant of the 5th King's Own Royal Lancaster Regiment, which has been rendering fine service in France since February.

General.—The marriage took place at the Independent Church, Llanfair Caereinion, on October 6th, of Mr. Evan Evans, electrical engineer, of Perthyfflin, Dinas Mawddwy, and Miss L. Jones, of Llanfair Caereinion.

Mr. D. B. Baddeley, manager for Scotland and the North of Ireland for Messrs. Crompton & Co., Ltd., having received a temporary commission in the Army Service Corps, will be absent from the Glasgow district for the period of the war. Messrs. Crompton are keeping his post open, but during his absence the management of the branch will be in the hands of one of his assistants.

Sapper H. A. P. Bale, from the London Electrical Engineers, has been appointed second-lieutenant, Hampshire Fortress Engineers.

The Council of the Institution of Electrical Engineers have elected Mr. J. E. Kingsbury to be honorary treasurer of the Institution in place of the late Mr. Robert Hammond.

Mr. Harry Mapes, of the staff of Messrs. Crompton & Co., Ltd., of the Arc Works, Chelmsford, who was married on October 2nd to Miss H. A. Willingham, has been presented by his colleagues with a set of cutlery.

At Rugby Parish Church, on October 5th, the marriage took place of Mr. Thos. C. Hurley, of the engineering staff of the British Thomson-Houston Co., Ltd., and Miss Winifred Neeves. Mr. Hurley is conductor of the B.T.H. Choral Society.

Mr. A. E. H. Dussek, of the Dussek Bitumen Co., who on account of ill-health has been away from business for the past three months, wishes his friends to know that he hopes shortly to have the pleasure of again meeting or calling upon them.

The Admiralty has made the following appointment:—Commander W. E. Prowse (Acting) to the *Ganges*, additional, for charge of Signal and Wireless Telegraphy Schools, Shotley (November 5th).

Mr. Joseph V. Gil has resigned his position with the British Westinghouse Co., designing electric railway control apparatus, and has this week taken up the appointment of assistant electrical engineer with Messrs. Matthews & Yates, of Swinton, Lancs.

Mr. Egerton J. Ward, A.M.I.E.E., was granted a commission in September last and posted to the 3rd Battalion, The Royal Irish Regiment.

Roll of Honour.—Corporal Tombs, of Chester, who has gained the Victoria Cross, is an electrical engineer who received his training in Yorkshire. He was engaged at Warrington when he joined the King's Liverpool Regiment. His brave action was the rescue of four wounded comrades under heavy fire, a task that took eight hours to accomplish.

Private George Wm. Smith, of the 1/5th Battalion West Riding Regiment (Huddersfield Territorials), was killed in action a few days ago by the bursting of a shell. He was 31 years of age, and was formerly employed in the electricity department of the Huddersfield Corporation.

Rifleman Tom West, 10th Battalion King's Royal Rifle Corps, who was on the electricity staff of Rochdale Corporation, has been killed in action.

Private Colin Chadwick, of the 7th Manchester Regiment, who was engaged at the works of Mirrlees, Bickerton & Day, Ltd., of Stockport, is reported to be missing, and believed to be killed, at the Dardanelles.

Second-Class Petty Officer G. B. Burgess, a member of the Beckenham U.D.C. electricity staff, has been awarded the Distinguished Conduct Medal for gallant service. Sergeant F. J. Fuller, shift engineer at the Council's works, has been mentioned in dispatches by Sir John French, and both have had sent to them the congratulations of the Council. Sergeant Fuller in 1905 joined the Electrical Engineer Volunteers, and he is in France with the Royal Engineers' Signal Company.

Private Benjamin Bond, of the 1/7th King's Own Royal Lancaster Regiment, formerly employed at the cable works of Messrs. Glover, Trafford Park, has been killed in action in France. He was 36 years of age.

Information has reached Kilmarnock of the death in action in France, on September 30th, of Second-Lieutenant Andrew Yates Young, 13th Scottish Rifles, attached to the 2nd Royal Scots Fusiliers. The deceased served his apprenticeship to engineering in the Glenfield Works, Kilmarnock, and after taking the Technical College course was engaged with the British Electric Plant Co., of Alloa.

The many friends of Mr. Arthur Jacob, of the British Aluminium Co., Ltd., will regret to learn that his only surviving son, Lieut. A. Leslie Hamilton Jacob, 18th Battalion London Irish Rifles, was killed in action, on September 25th, in France. Lieut. Jacob, who was 19 years of age, was born in Dublin in 1896, and educated at Bowden House, Seaford and Felstead, Essex. He was gazetted in September last, and obtained promotion in May.

Obituary.—Mr. Charles Swain Agnew, of Southport, a member of the firm of Messrs. J. H. Agnew & Bro., grey cloth agents, Manchester, who died last Friday at the age of 79 years, was a director of the National Telephone Co. before the telephones were taken over by the Government.

NEW COMPANIES REGISTERED.

W. A. and R. J. Jacobs, Ltd. (141,783).—This company was registered on October 6th, with a capital of £3,000 in £1 shares, to carry on the business of manufacturers of electrical apparatus and fittings, electric lamps, and cycle and motor accessories of all kinds, metal workers, japanners, enamellers, electro-platers, galvanisers, general engineers, manufacturers of goods in glass and iron, steel and other metals, etc., and to enter into an agreement with W. A. Jacobs and R. J. Jacobs. The subscribers (with five shares each) are: W. A. Jacobs, 94, Leonard Street, E.C., manufacturer; R. J. Jacobs, 94, Leonard Street, E.C., manufacturer. Private company. The number of directors is not to be less than two or more than three; the first are W. A. Jacobs and R. J. Jacobs (both permanent). Qualification, £5. Remuneration as fixed by the company. Registered office: 94, Leonard Street, Finsbury, E.C.

Feltham and District Electric Lighting Co., Ltd. (141,806).—This company was registered on October 8th, with a capital of £100 in £1 shares, to carry on the business of generators, producers and distributors of electrical energy for lighting, power or traction purposes, within the area of supply mentioned in the first schedule to the Feltham and District Electric Lighting Order, and to adopt an agreement with F. H. Edwards. The subscribers (with 10 shares each) are: C. E. Baker, 35, Parliament Street, Westminster, solicitor; W. Garner, 164, High Street, Hounslow, solicitor; J. E. Drower, 28, Victoria Street, S.W., quantity surveyor; F. H. Edwards, 76, Cheapside, E.C., solicitor. Private company. The number of directors is not to be less than three or more than six; the subscribers are to appoint the first. Qualification, £10. Remuneration as fixed by the company. Solicitors: Baker & Sons, 35, Parliament Street, Westminster.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bland Light Syndicate, Ltd. (97,494).—A memorandum of satisfaction to the extent of £1,500 (leaving balance outstanding of £3,500) on August 30th, 1915, of debentures dated October 14th, 1913, nominally securing £6,000 (of which £5,000 has been issued), has been filed.

Pintsch's Electric Manufacturing Co., Ltd. (in voluntary liquidation).—Charge on hereditaments and premises, etc., dated September 16th, 1915, to secure not more than £350. Holders: Pintsch's Patent Lighting Co., Ltd. (in voluntary liquidation), Friars House, New Broad Street, E.C.

Carville Site and Power Co., Ltd.—Issue, on September 28th, 1915, of £10,000 debentures, part of a series of which particulars have already been filed.

John Davis and Son (Derby), Ltd.—Capital, £35,000 in £1 shares (15,000 pref.). Return dated July 9th, 1915. 15,000 ord. and 11,000 pref. shares taken up. £1 per share called up; £26,000 paid. Mortgages and charges: Nil.

CITY NOTES.

Quebec Railway, Light, Heat and Power Co., Ltd.

At the annual meeting, held in Montreal on September 14th, the directors presented their report for the fiscal year ended June 30th, 1915. The gross earnings from operation were $1,548,096, an increase of $16,875. After adding miscellaneous income of $235,978, the total revenue from all sources was $1,784,074, an increase of $17,076. The operating and main-

tenance expenses were $924,817, an increase of $11,716. The fixed charges and taxes of all kinds amounted to $739,482, leaving a net surplus of $119,775, which, added to that of last year, leaves a total surplus to date of $347,499. The properties and plants of the company and its various subsidiary companies have been maintained in the same high state of efficiency as heretofore, as evidence of which there was expended during the year on maintenance account $193,897.

Dick, Kerr & Co., Ltd.

The directors' report for the year ended June 30th, 1915, states that the profits earned amount to £46,960, which added to £25,525 forward from last year makes a total of £72,485. Out of this sum the debenture interest and trustees' fees have been paid, and there has been reserved the sum required to provide for the premium payable on the redemption of the present debenture stock. These items absorb £10,839, leaving £61,647 available for appropriation as under:—A dividend of 6 per cent. per annum on the preference share capital [Note.—The half-yearly dividends to December 31st, 1914, and June 30th, 1915, have already been paid.] £18,300, setting aside as a reserve against contingencies £25,000, and carrying forward £18,347. In view of the abnormal conditions prevailing, the directors are unable to recommend the payment of a dividend on the ordinary shares.

The meeting is called for October 21st.

Swiss Escher Wyss & Co.

The report of Escher Wyss & Co., of Zurich and Ravensburg, for the year ended with March 31st, 1915, refers first to the influence on the undertaking of the outbreak of the war and the mobilisation, and to the efforts made to maintain working. In the autumn it was believed that the lowest level of the depression had been overcome, and as orders gradually came to hand in increasing numbers it was eventually possible to resume full-time working, although with a reduced number of workmen, owing to the call to the Colours. The greatest difficulties were still encountered in the securing of orders and the provision of raw materials and semi-finished products, and also in the forwarding of deliveries. The multiplicity of the branches of manufactures was of advantage in connection with the rapid accommodation of the company to the changing requirements and conditions of the economic life. Although all departments were affected by the unfavourable times, the branch for steam and hydraulic turbines probably suffered the least. The steam turbine department had to deal with a large stock of orders brought forward from the previous year, and new orders were received to a large extent, mainly for smaller machines. The work of the hydraulic turbine shops had to be limited more to the construction of small plant, for which abundant occupation was available, chiefly on the part of works having their own motive power, such as spinning and weaving mills, etc., to which the war had brought orders in an increased measure, and which were, therefore, encouraged to proceed with extensions of their works. The work on the enormous machines for the Barcelona Traction, Light & Power Co. had to be suspended for several months, but the recent reorganisation of this group assured the delivery of the machinery. After devoting £21,000 to depreciation, as compared with £29,000 in 1913-14, the accounts exhibit net profits of £13,000, as against £22,000, and a dividend of 4 per cent. has been declared on share capital of £260,000, this comparing with 6 per cent. in the preceding year.

German Electrical Companies.

The Stickstoff Werke, A.G., of Herringen, near Hamm, which company was formed by the firm of de Wendel, and, together with the latter, is under Government supervision on account of the war, reports a loss of £1,800 for 1914-15, as against a loss of £360 in the preceding year, the deficit thereby being increased to £2,800 on a share capital of £50,000.

The gross profits earned by the *Deutsche Elektrizitats Werke Garbe, Lahmeyer & Co., of Aix-la-Chapelle* in the year ended March 31st, 1915, amounted to £60,000, as compared with £104,000 in the previous year. After defraying general expenses and setting aside £14,000 for depreciation, as against £16,000 in 1913-14, the accounts indicate net profits and balance forward of £20,000, as contrasted with £28,000, and a dividend of 5 per cent. has been declared, as in 1913-14.

The Suddeutsche Telephon Apparatus, Kabel und Drahtwerke, of Nuremberg, which belong to the group of the Felten and Guilleaume Co., earned gross profits of £46,000 in 1914-15, as contrasted with £15,000 in the previous year. After meeting general expenses and allocating £17,000 for depreciation, as against £4,400 in 1913-14, the accounts show net profits of £14,000, as compared with £1,700 in the preceding twelve months. The latter amount was carried forward; the method of disposing of the present balance is not disclosed in the official accounts.

The report of the *Kabelwerk Rheydt, A.G., of Rheydt,* for the twelve months ended with June, 1915, states that the demand for the company's manufactures decreased. In the course of time the deliveries, except for war purposes, entirely ceased, as all essential materials were only permitted to be used for these objects, and the company continued to be occupied with contracts of this character. The gross profits realised in 1914-15 amounted to £175,000, as compared with £131,000 in the preceding year, and the net profits, after apportioning £25,000 to depreciation (chiefly of the cable factory and rolling mill), as contrasted with £20,000 in 1913-14, were £140,000, as against £83,000. It has been decided to pay a dividend of 18 per cent., the rate for 1913-14 having been 12 per cent.

The directors of the *Isaria Zahlerwerke, A.G., of Munich,* which is associated with the Brown-Boveri group, states that the outbreak of the war at first caused almost a complete stoppage of business, although a resumption took place gradually to the extent that business became almost normal with the exception of the relations with hostile countries. A partial compensation for the decline in export trade was afforded by the orders received from the Army authorities, but the decrease in the profits was attributed solely to the effects of the war. After placing £6,300 to depreciation in 1914-15, as compared with £7,100 in the previous year, the accounts show net profits of £10,500, as against £17,400, and a balance of £26,000 and £22,000 in the two years respectively, inclusive of the balance brought forward. It is proposed to pay a dividend of 10 per cent. on share capital of £110,000, as against 5 per cent. in 1913-14. It is, further, mentioned that the orders on hand for peace purposes are satisfactory, and further orders have been received from the Army authorities.

The report of *Brown, Boveri & Co., of Mannheim,* for the year ended March 31st, 1915, states that the production and deliveries were considerably less than the normal figures in consequence of the war, and the receipt of raw materials was in part greatly hindered. The stoppages in working caused through the calling-up of men on the outbreak of the war were overcome in a comparatively short time in so far as it was possible having regard to the conditions created by the war. Nevertheless, the value of the turnover was materially less than in 1913-14. According to the assets side of the accounts, the value of the investments and other financial interests in undertakings rose from £63,000 in 1913-14 to £147,000 last year, chiefly through the payment of further instalments on ordinary shares in the Turbinia Co., the Electric Power Supply Co., and the Rhenish Wire & Cable Works, and through subscriptions to the war loans, the last mentioned being the only reference in the report to any participation in the war. The gross profits, including receipts from investments, amounted to £193,000, as contrasted with £207,000 in 1913-14. After providing for general expenses, interest on loans which total £354,000, and allocating £29,000 to depreciation, as against £33,000, the accounts represent net profits and balance forward of £34,000, as compared with £35,000. It is intended to pay a dividend of 5 per cent. on the paid-up capital of £450,000, being the same rate as in the previous year.

Adelaide Electric Supply Co., Ltd.

An extraordinary general meeting of shareholders was held on Monday at the offices, Finsbury Pavement House, E.C., under the presidency of Mr. Percy R. Sellon.

The Chairman, after explaining that he occupied that position owing to the absence of Mr. Braithwaite, the Chairman of the company, who had been suddenly called to the United States on business, proposed the following resolution:—

> That the capital of the company be increased from £500,000 to £750,000 by the creation of a further 50,000 shares of £5 each; and that the directors be and they are hereby authorised to issue such further shares as ordinary or preference shares (subject when necessary to the consent of the holders of the company's existing 6 per cent. cumulative preference shares), in such amounts, at such price or prices, to such persons, and at such times, as the directors may from time to time determine.

He said the directors asked for sanction to increase the capital in order to meet the demands of the business. The capital powers of the company were now practically exhausted, the whole of the preference and ordinary shares having been issued. It might be said: was this a proper moment at which to involve ourselves in further capital expenditure? The explanation was simply this—that whereas in the case of a private industrial undertaking it was quite possible to exercise discretion as to whether capital increases should be incurred or not at any given moment, in the case of a company operating under statutory powers there was no choice in the matter. They were compelled under certain conditions to incur such capital expenditure as might be necessary at any given time in order to carry out their obligations to supply light and power to those who applied for it. The war had naturally exercised a somewhat adverse effect upon electricity supply undertakings everywhere, but the directors were very happy to be able to say that so far as their undertaking at Adelaide was concerned, it had by no means had the effect of stopping the flow of demand for light and power upon their mains, or the necessity for extensions of mains under the terms of their statutory obligations in those districts where fresh demands arose. For that purpose they were compelled to raise additional capital. Just how and when it would be necessary to make a further issue, and under what conditions, was a matter which at the moment

was engaging the attention of the board in consultation with the local board at Adelaide and their officials on the spot. They proposed to deal with that question when they had the whole of the data at their disposal.

Mr. Benjamin Brookman seconded the resolution, which was carried unanimously.

Companies Struck off the Register.—The following companies have been struck off the Register and are accordingly dissolved:—

British Automatic Telephone Syndicate.
British Magneto Co.
Consolidated Electric Works & Appliances.
Eclipse Boiler Furnace (London & South).
"Electricity."
Gambles' Patent Telephone Recorder Co. (Continental).
Haywards Heath Electric Supply Co.
Magnetic Separator.
Pacific Radiotelegraph Co.
Premier Electric Control.
Radio and Electric Power Co.
Rail and Road Traction.
Silent Day Engine Syndicate.
Spiral Turbine Syndicate.
Sunturbo Engineering Co.
Tramways Construction Syndicate.
Tungsten Metal Co.
United Electrical Construction Syndicate.

Official Notices re Companies.—The following companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary:—

Brabbins Fuelless Engine Syndicate.
Budleigh Salterton Electric Light & Power Co.
Economic Coaling Appliance Co.
Emanda Engineering Co.
Liverpool Traction, Light & Power Investment Trust.
Maximum Magneto Co.
Oil and Gas Turbine Syndicate.
Russian Wireless Telegraph Trust.
Telenews.
Vacuum Electric and Gas Heating Appliances.
Walker Reversible Turbine Co.

Oriental Telephone and Electric Co., Ltd.—The directors have declared the following interim dividends:—3 per cent. on the 6 per cent. cumulative preference shares for the current year, less income tax, and 4 per cent. on the ordinary shares, free of income tax. The warrants will be posted on 30th inst.

STOCKS AND SHARES.

Tuesday Evening.

The attitude of the Stock Exchange at present is distinctly a waiting one. Some men regard the news as bad; others, as satisfactory. Between the two schools of opinion there is sufficiently wide divergence to check business, since times of doubt and perplexity hold a restraining rein upon investment and speculative investment. There is a certain amount being done in both classes, but not sufficient to affect prices in any material manner. Fresh impetus has been given to the boom in American rails by a fall in the early part of the week in the rate of exchange, this following upon an outburst of bullishness in New York which caught up prices of railroads and industrials alike. In the electricity sections, the strongest continues to be that for telegraph issues. Mexicans have dipped, but Brazil Tractions keep comparatively steady. The Stock Exchange has decided to pay no interim dividend on its own shares, which are £13 paid, received £4 a share dividend this time last year, and now stand about £70.

The Excess Profits Tax continues to engage lively attention in City and in manufacturing circles. Publication of the full details of the Bill is eagerly awaited. Discrimination will have to be applied in so many cases, if the law is to be administered with equity and logic, that whatever tribunal may be set up will undoubtedly have an enormous task in front of it when it comes to sift the liable from the exemptable. The rubber-growing industry alone can furnish hundreds of companies that vary considerably in degree of fitness for exemption. These columns contain no wardrobe for the prophet's mantle; but if they did, we should pick out the one marked General Dissatisfaction as likeliest to fit the majority of cases concerned, although it would be easily enveloped by the wider cloak of Patriotism.

The Electricity Supply list is steady in most of its prices. A fall of ⅛ to 4⅝ has occurred in London Electric 6 per cent. preference shares; save for this, the catalogue is unchanged. Candour compels the admission, all the same, that there are prospective sellers about of various shares for which buyers are lacking; but quotations remain without alteration, because war experience has shown there is little use in putting prices down when buyers are holding aloof. Levels may be artificial now; but it is contended that they would be misleading if dropped, or raised, 10 or 20 points, should there still be no buyers in the first place, or sellers in the second.

The announcement that some sort of relief is to be afforded to the obscuring of London lights is welcome to holders of electricity supply shares in the London companies. If this modification were to be accompanied by a few simple safeguards against accidents—such, for instance, as requiring curbstones to be whitened—the risk of winter accidents would be greatly lessened.

The difficulties in the way of raising money through the medium of new issues are well enough known; and invitations to the public to subscribe are put forward sparingly. Several corporations have recently invited tenders for loans upon specified security. For instance, Wednesbury, the well-known Staffordshire town, early this week advertised that its Town Council would receive tenders for certain loans, amongst which occurred, under the heading of Electric Light, three amounts, namely: £3,086 for 18 years, £460 for 30 years, and £600 for 25 years. A couple of lines suffices to give the information that the rateable value of the town is £102,000, the rates 9s. 8d. in the £, the debt £100,086, and sinking funds £12,079. Obviously, therefore, the security is excellent; and it would be interesting to know on what terms Wednesbury obtains the money.

Mexican prices have given way, as noticed above. There are falls in Mexico Tramways bonds, Mexican Light & Power preferred and first mortgage bonds. This is somewhat remarkable, in light of the recognition which the United States is said to have accorded to General Carranza and his Government—a concession which, by the way, naturally arouses wonder in the mind of the British V.T.C. member as to whether the Carranzist will now be permitted to wear a red brassard on the left arm, inscribed with the letters G.R. Most of the railway issues connected with Mexico have improved, and no doubt those of the commercial undertakings will follow suit when the present trifling amount of stock which is on offer has been absorbed. Anglo-Argentine Tramways stocks are rather better, but Brazil Tractions moved down a small fraction in consequence of a slight decline in the Rio exchange.

There has been a further outbreak of activity in Canadian industrials. Apart from munitions, the harvest in the Dominion bids fair to tax all the efforts of the Canadians to deal with it, and it is declared that the current year's crops will show an increase of at least 90 per cent. over those of the previous twelvemonth—which, however, it must be recalled, was a somewhat lean period. So Shawinigan Water and Power common has risen several points to 137, ex the dividend of 1½ per cent. deducted last week. Consolidated Gas, Electric Light & Power of Baltimore have held their improvement at 110¾, though Kaministiquia is still dormant, the shares not having changed hands for nearly six months. There is a fair amount of business in Victoria Falls preference shares on the basis of 17s., the ordinary being 4s. 9d., and the second mortgage debentures in the neighbourhood of 90.

The Home Railway market is a dull one. There seems to be no interest taken in any of the stocks. A little languid business goes on day by day in Underground Electric income bonds, but even here, notwithstanding the high yield, there is no recovery in the price: in fact, at 71, last week's small gain has been lost. Metropolitans have eased off to 23, and Districts failed to recover from 13. There is more doing in the preferred stocks, which can be bought to pay 5½-6 per cent. on the money. In the ordinary group, public interest is very slender.

New York Telephone 4½ per cent. bonds are 1¼ up at 101, thanks once more to a fall in the American rate of exchange. The Anglo-French loan up to the present has hardly justified the expectations that were formed of its being able to rectify the weakness of the exchange position; and everything connected with the United States, in the way of securities, is booming on both sides of the Atlantic. Oddly enough, American Marconis have not moved; the price, in fact, is a little dull at 18s. 3d., and the parent shares went back to their previous figure of 1⅞. Canadian Marconis remain at 5s. 6d.

The demand for American securities directs attention to Anglo-American issues; and those of the cable companies are mostly better on the week. Both preferred and deferred stocks of the Anglo-American Telegraph Co. have advanced. Direct United States Cable shares are higher at 6. Another brisk advance took Indo-Europeans to 47, so that their slump of a fortnight ago has been nearly recovered; and the fortunate people who picked up the shares at 36½ may well congratulate themselves upon their perspicuity. United River Plate Telephones again rose ¼, and Western Telegraphs are similarly better at 12½. On the other hand, West India and Panama shares eased off to a sovereign.

Amongst manufacturing shares, Henleys have been done at 12 13-16 and also at ⅜ lower, while the company's 4½ per cent. preference shares (of £5 each) are 4¾, and the 4½ per cent. 1st mortgage debenture stock is nominally about 92, with a full half-year's interest due in the middle of next month, allowing for which the yield on the money comes to all but 5 per cent. Babcock & Wilcox are unaffected by the dividend, published here last week. Edison & Swan 4 per cent. debenture stock is a little lower. Castner-Kellners are firm at £3. The rubber market is sustained by the price of the raw material having risen to 2s. 6d. per lb. There is, moreover, a little business doing in this section; and people are spending money on the best-class rubber shares, which can be bought to pay 10 per cent., putting these away with their gilt-edged securities with a view to the establishment of a 6 per cent. all-round yield upon investments made at the present time. This rate seems to be a perfectly reasonable one to expect, in present conditions—more particularly when it is remembered that within the next few months there is certain to be another War Loan, which can hardly fail to have a directly competitive effect upon all existing stocks and shares.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Oct. 14, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£8 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	8⅜	—	6 13 4
do. do. do. 4½ Pref.	4½	8⅜	—	6 0 0
do. do. City Pref.	4½	8½	—	6 8 7
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	87	—	5 8 6
City of London	9	12½	—	7 7 0
do. do. 6 per cent. Pref.	6	10⅝	—	5 11 4
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10½	—	6 16 7
do. do. 6 per cent. Pref.	6	10½	— ½	5 17 3
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	85	—	5 6 0
Kensington Ordinary	9	6⅝	—	7 4 0
London Electric	4	1⅝	—	8 8 4
do. do. 6 per cent. Pref.	6	4⅝	— ½	6 9 9
do. do. 4 Deb.	4	80	—	5 0 0
Metropolitan	8½	9½	—	7 15 7
do. 4½ per cent. Pref.	4½	8⅜	—	6 0 0
do. 4½ Deb.	4½	90	—	5 0 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6⅝	—	7 8 2
do. do. do. 7 per cent. Pref.	7	6⅛	—	5 12 0
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2⅝	—	6 19 0
South Metropolitan Pref.	7	1⅞	—	6 14 0
Westminster Ordinary	9	6⅜	—	6 18 4
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	100½	+1	5 19 6
do. Def.	1½	22½	— ⅛	6 16 4
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	—	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	117	— ½	*6 14 9
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	119	+1	*6 14 7
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	80	—	5 0 0
Globe Tel. and T. Ord.	6	93	—	*7 0 8
do. Pref.	6	93	—	6 3 0
Gt. Northern Tel.	22	83	—	6 13 4
Indo-European	18	47	+2	6 18 4
Marconi	10	17⅛	— 1/16	6 8 0
New York Tel. 4½	4½	101	+1½	4 9 0
Oriental Telephone Ord.	10	145/8	—	6 8 1
do. Pref.	6	1	—	6 0 0
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅝	+ ⅛	*8 2 6
do. Pref.	5	4⅛	—	6 2 7
West India and Pan.	1	1	— ⅛	10 0 0
Western Telegraph	7	12½	+ ⅛	*6 13 4
do. 4 Deb.	4	80	—	5 0 0
Home Rails.				
Central London, Ord. Assented	4	69	—1	5 16 0
Metropolitan	1½	23	— ½	5 8 8
do. District	Nil	13	—	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	5/6	—	Nil
do. do. Income	6	71	— ½	*9 11 8
Foreign Trams, &c.				
Anglo-Arg. Trams, First Pref.	5½	8⅜	—	7 17 2
do. 2nd Pref.	5½	8	—	9 8 4
do. 4 Deb.	4	74	+1	5 8 1
do. 4½ Deb.	4½	72	—	6 5 0
do. 5 Deb.	5	75	+1	6 13 4
Brazil Tractions	3½	49½	— ½	7 1 5
Bombay Electric Pref.	6	10⅝	—	5 17 1
do. 4½ Deb.	4½	87	—	5 3 0
Mexico Trams	Nil	88	—	Nil
do. 5 per cent. Bonds	—	37	—8	Nil
do. 6 per cent. Bonds	—	85	—	Nil
Mexican Light Common	Nil	23	—2	Nil
do. Pref.	Nil	30	—	Nil
do. 1st Bonds	—	37	—8	—
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	97	—1	5 3 0
Manufacturing Companies.				
Babcock & Wilcox	14	2⅜	—	6 8 5
British Aluminium Ord.	5	1⅞	—	4 14 1
do. Pref.	6	18/8	—	6 9 9
British Insulated Ord.	15	108	—	7 1 2
do. Pref.	6	5⅜	—	5 2 2
British Westinghouse Pref.	7½	84/-	—	8 10 8
do. 4 Deb.	4	72	—	5 11 1
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11	—	6 16 4
do. 5 Pref.	5	4½	—	5 11 8
do. 4½ Deb.	4½	92	—	4 17 2
Castner-Kellner	15	61/-	—	4 18 6
Edison & Swan, £8 pd.	Nil	10/-	—	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	57	—1	7 0 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	13/-	—	9 4 8
do. do. Pref.	7	19/9	—	7 1 4
Gen. Elec. Pref.	6	9⅝	—	6 6 4
Henley	20	12½	—	*9 2 0
do. 4½ Pref.	4½	4½	—	5 0 0
do. 4½ Deb.	4½	92	—	4 17 2
India-Rubber	5	8	—	6 5 0
Telegraph Con.	20	31	—	7 15 0

* Allowance made for dividends being paid free of income-tax.

Indo-European Telegraph Co., Ltd.—The directors have declared an interim dividend for the half-year to June 30th at the rate of 5 per cent. per annum, free of income tax.

Indian Electric Supply and Traction Co., Ltd.—The directors have declared an interim dividend of 2½ per cent.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, October 13th.

CHEMICALS, &c.		Latest Price.	Fortnight's (no. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a „ Nitric	„	..	..
a „ Oxalic	per lb.	1/-	..
a „ Sulphuric	per cwt.	..	..
a Ammoniac Sal	„	..	..
a Ammonia, Muriate (large crystal)	per ton	£50	£6 inc.
a Bleaching powder	„	£9	..
a Bisulphide of Carbon	„	£23	..
a Borax	„	£23	..
a Copper Sulphate	„	£28	..
a Lead, Nitrate	„	..	..
a „ White Sugar	„	..	..
a „ Peroxide	„	..	..
a Methylated Spirit	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	..	..
a Potash, Caustic (88/90 %)	per ton	..	..
a „ Chlorate	per lb.	1/4½	..
a „ Perchlorate	„	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	„	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	..	..
a Sulphur, Sublimed Flowers	„	£11 10	..
a „ Recovered	„	..	..
a „ Lump	„	£8 10	..
a Soda, Caustic (white 70/73 %)	„	..	..
a „ Chlorate	per lb.	1/3½	..
a „ Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	5½d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b „ Wire, in ton lots (1 to 14 S.W.G.)	„	..	..
b „ Sheet, in ton lots	„	..	..
g Babbitt's metal ingots	„	..	..
c Brass (rolled metal 2" to 12" basis)	per lb.	1/0⅞ to 1/1	..
c „ Tubes (solid drawn)	„	1/1½ to 1/1⅝	½d. inc.
c „ Wire, basis	„	1/1½ to 1/1⅝	..
c Copper Tubes (solid drawn)	„	1/1½ to 1/1⅝	½d. inc.
g „ Bars (best selected)	per ton	£100	£4 inc.
g „ Sheet	„	£100	£4 inc.
g „ Rod	„	£100	£4 inc.
d „ (Electrolytic) Bars	„	£88 10	10/- inc.
d „ „ Sheets	„	£106 10	10/- inc.
d „ „ Rods	„	£95 10	10/- inc.
d „ „ H.C. Wire	per lb.	11½d.	..
f Ebonite Rod	„	8/-	..
f „ Sheet	„	2/6	..
n German Silver Wire	„	1/10	..
h Gutta-percha, fine	„	6/10	..
h India-rubber, Para fine	„	2/5½	1d. inc.
l Iron Pig (Cleveland warrants)	per ton	64/6½	3½d. dec.
l „ Wire, galv. No. 8, P.O. qual.	„	£26	..
g Lead, English Pig	„	£25	..
g Mercury	per bot.	£15 15	..
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e „ „ „ medium	„	8/6 to 6/-	..
e „ „ „ large	„	7/6 to 14/- & up.	..
o Nickel, sheet, wire, &c.	„	Nom.	..
p Phosphor Bronze, plain castings	„	..	..
p „ „ rolled bars & rods	„	..	..
p „ „ rolled strip & sheet	„	..	..
o Platinum	per oz.	190/-	..
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£85	..
g Tin, Block (English)	„	£149 to £150	..
n „ Wire, Nos. 1 to 16	per lb.	2/7	..
p White Anti-friction Metals	per ton	..	..
k Zinc, Sh't (Vieille Montagne bnd.)	„	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Hurst Nelson and Co., Ltd.—For the year ended July 17th, after providing for depreciation, etc., and including £16,811 brought forward, £68,390 was available. After placing £13,694 to reserve to secure the preference dividend, and £15,000 to general reserve, a dividend of 10 per cent. on the ordinary shares is being paid, leaving £15,696 to be carried forward.

Cuba Submarine Telegraph Co., Ltd.—Interim dividends for the six months ended June 30th, at the rate of 10 per cent. per annum, subject to income tax, on the preference shares, and at the rate of 5 per cent. per annum, free of tax, on the ordinary shares.

New Issue.—The Aluminium Corporation, Ltd., has been offering the balance of its first debenture stock to the preference and ordinary stockholders at par.

United River Plate Telephone Co., Ltd.—The directors have declared an interim dividend of 3 per cent. on the ordinary share capital for the half-year to June 30th.

THE ISOLATION OF VIBRATIONAL DISTURBANCES.

By FRANCIS H. DAVIES.

The suppression of vibration from running machinery is a problem that has always been with the engineer, but never more so than at present. Modern conditions involving heavier and more complex machinery and higher rates of production have all tended to this end, and the increasing employment of the steel frame factory building which, unless specially designed, affords every facility for the transmission of vibrational disturbances, has given further prominence to the importance of the question. Numerous instances might be cited to show that the attitude of the law in cases of nuisance arising from the operation of machinery is becoming more merciless to the transgressor, a fact which claimants seem to be fully aware of, and it is no uncommon thing in such cases for substantial damages to be awarded, or even for the plant to be shut down under an injunction. The position has naturally created a demand for effective methods of isolation, and the demand has been met by several means which are interesting, and, for the most part, decided advances over the somewhat crude and unsatisfactory earlier methods. To a certain extent these older and more primitive systems of isolation still have their uses, chiefly in connection with very small plant or in situations abroad where rough and ready devices often have to be adopted. There is a good variety of them, but one and all they fail in greater or less degree to fulfil the conditions which experience has proved to be essential. To be thoroughly effective, an isolating medium, whether employed in connection with prime movers or driven machinery, must be of such a nature that continued pressure and vibration will not cause it to take a permanent set and thus lose its elasticity. This is the most important point and the one by which all isolating materials should chiefly be judged. Further, it is essential that the substance should be as impervious as possible to the attacks of insects, rats, oil, damp and climatic changes, as in these respects its position, either under the foundation or on top of it directly under the bedplate, is naturally an unfavourable one. Comparative inexpensiveness in this matter is not a virtue, and it should not be allowed to enter into the question. The amount at stake is generally too great, and it must be remembered that it is always a costly matter to renew or replace such isolators if this entails the lifting of a heavy machine or the destruction and rebuilding of a concrete foundation.

What is wanted is a material which will last and retain its resiliency indefinitely, and in the very nature of things such a substance cannot be bought cheaply. The earlier and cruder systems, most of which do not provide any real solution of the difficulty, may be listed and criticised as follows :—Timber baulks, generally of pine, elm or beech, creosoted or otherwise prepared to resist decay, are insufficiently resilient and for most purposes useless. Ordinary builders' felt and sheet lead used, either singly or in combination, will temporarily meet the case of small plant, but will ultimately lose practically all resiliency. Hair felt placed in a tray in order to keep it from being squeezed out under pressure, is fairly satisfactory for the lightest of machinery, but quite out of the question for heavy plant. Asphalt, also placed in a tray for the same reason, and about ½ in. thick has been recommended, but again, its sphere would be restricted to small plant, and it is very doubtful whether the low resiliency it possesses would be of much service. As an alternative, an asphaltic concrete has been employed with somewhat better results. Mastic asphalt is heated to about 350° Fahr., and is mixed with 50 per cent. of its weight of boiler scale in pieces about the size of macadam stone. It is then reheated to about the same temperature, and when cooled becomes a slightly resilient mass, suitable for installing under a foundation. It will possess more resiliency than pure asphalt, but is not comparable in this respect to the various special materials now made for the purpose of absorbing vibration, and is, therefore, not so efficient. Raw hides soaked in oil and placed under the bedplate have been used, but while probably of some service for temporary purposes, such a choice cannot be recommended for permanent work.

A 6 in. layer of fine dry sand or medium sized gravel is always helpful under a foundation if kept dry and properly restrained from lateral spreading. It is serviceable, and often used where a foundation bears down on a vein of rock, which it is well known will transmit vibration over great distances. Interposed between the rock and the foundation, such a layer will damp out a good deal of the disturbance, but it cannot always be regarded as a thorough solution to what is often a very difficult problem, and should therefore not be solely depended upon in a bad case. Other materials which have been advocated are sawdust and granulated cork, but like all such substances, their sphere of utility is very limited, and in view of modern improvements they are only worthy of consideration where nothing better is at hand.

A good method of constructing a sand cushion foundation is shown in fig. 1. The hole destined to contain the concrete block is lined on all sides with 6 in. or so of concrete, forming a well. The requisite depth of dry sand is

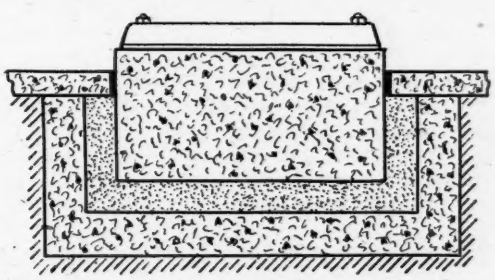


Fig. 1.—Isolation by means of Sand Cushion.

then shovelled in and levelled, and on top is placed a sheet of oiled paper or similar waterproofed substance. The wooden mould or form for the foundation is then placed in position and the concrete poured. When set, the form is removed and the spaces at the sides of the block are filled in with sand up to a few inches from the top. The floor is then completed up to about 1 in. from the sides of the foundation, and, if possible, more sand is fed in through this gap until the space is quite full, the gap itself being closed by a ring of asphalt which to a sufficient extent isolates the foundation from the floor.

The object of this construction is to prevent sand being forced out at the top, as this would, of course, lead to settlement. An alternative method is to use metal plates, which being embedded in the part of the floor immediately surrounding the foundation and projecting across the gap until they touch the block, serve the purpose of closing all exit for the sand. The objection to such plates is that to some extent they will conduct vibration from the foundation to the floor.

Before examining the latest practice in the matter of isolating materials, it may be advantageous to touch upon the question of vibration generally, to the extent of indicating the manner in which it is propagated by different types of engines and transmitted through the soil. It is essential that these points should be clear, as otherwise a well devised system may prove useless through misapplication. Leaving out of the question the causes of vibration in an engine or machine, which alone constitute a vast and very complicated subject, we come directly to the effects, and these are found to differ materially according to the type of engine. Vibration is never of a simple nature, that is to say, of a fixed amplitude and direction. In all machines the disturbance felt is the net result of numerous disturbances set up individually by every part which is capable of generating vibration. Thus, if we assume the case of a badly-balanced engine with a slightly sprung shaft, there are at once two main sources of vibration, not to mention minor sources, such as comparatively small reciprocating and unbalanced parts. The effects of the latter are, of course, largely overwhelmed by those of the former, which, being far heavier, preponderate. However, it is found that every

class of engine has characteristics in this direction which may be taken as typical, and which always predominate. Thus, the disturbances set up by a horizontal engine are mostly in the horizontal plane, and for equally obvious reasons a vertical engine generates vibrations in a more or less vertical direction, the effect of which is to cause the engine and its foundation to move bodily up and down. Both types also tend to set up a tilting oscillation, particularly two-line vertical engines. So long as the problem is confined to a single engine or machine mounted on its own foundation, it is comparatively simple; but when, as is often the case, we have to consider the joint effect of several engines, possibly of different types and speeds, erected on one large foundation block, it becomes complicated. Occasionally the vibrations set up by the various engines will synchronise, producing a maximum effect, and this will be followed more or less regularly by periods of comparative quiet. This phenomenon has often been observed, especially where the installation consists of high-speed engines, the vibrations of which come more frequently into phase than those of low-speed sets. So far as disturbance is concerned the latter are, however, the greater offenders, the larger amplitude of their vibrations being more marked and more annoying than those of high-speed engines, the vibrations of which are for equal power of smaller amplitude, though of greater frequency.

The problem is further complicated where alternating-current generating sets running in parallel are concerned. If, as is very seldom the case, all the sets are of the same type, capacity, and speed, the intensity of the net vibrational disturbance they will set up is a matter of chance, depending entirely upon the relative angular positions of the cranks at the instant of paralleling, and whatever the result may be, it will be constant (except for load variations), because the relative speeds of the engines cannot alter. If, however, the sets are of different speed, the effect will be entirely changed, and periods of maximum and minimum disturbance will occur, even though the generators are running synchronously. Of course, if the sets are each mounted on an independent foundation, the net result may again be different, but it is quite impossible to say to what extent, as all the peculiar conditions surrounding the case would have to be taken into full account. Since the disturbances set up by horizontal engines are mostly in the horizontal plane, it follows that the chief consideration is to keep the foundation clear of the soil on all sides. Vibration can then only be transmitted by the base, and if this is isolated by some suitable material, and also by a layer of dry sand or gravel, the spreading of disturbances is unlikely to be serious, unless there is a very marked vertical disturbance as well. It is, of course, more difficult to isolate vertical vibration, and such cases demand more care and more thorough methods. It is helpful, but by no means sufficient to leave a clearance all round the foundation block, and while this is perhaps the most important point with horizontal engines, it is the base of the foundation which calls for the greatest care where the plant is of the vertical type. In the great majority of cases the mass of a foundation in conjunction with the soil immediately around it is sufficient to absorb any disturbance which the machine it carries may set up, and this is, of course, one of its principal functions. Should it be unable to do this, either because its mass is insufficient, the engine particularly badly balanced, or because the subsoil under the foundation is of a nature that very readily transmits such disturbances as are communicated to it, some special method of isolation becomes necessary. It is well understood that soils vary greatly in their power of transmitting vibration. The two extremes of hard rock and wet unstable soil are the worst sinners in this respect, and the effects which they give rise to are at times very curious and difficult to follow. Vibration is often plainly discernible at one particular spot at a considerable distance from its source, the intermediate ground being entirely free from it. This may possibly be accounted for by a vein of rock which carries the disturbance at some depth to a point where it rises to the surface, and where the trouble becomes apparent. It has also been traced to an underground stream or vein of wet soil, and in such cases the vibration is always more marked after wet weather. If the subsoil is uniform in nature, the disturbances communicated to it by the foundation will spread more or less equally in all directions, and will gradually diminish as they are absorbed by the soil. This represents the conditions in the average case, and should they differ in this respect it is fairly certain that the soil is irregular in nature. The interest of the case is enhanced thereby, but unfortunately the difficulty and cost of overcoming the trouble will also probably be enhanced.

One mistake in design which is not common, but which has at times been made, is to install plant upon a concrete raft or floor which is securely tied to the wall foundations of the building. This is practically equivalent to erecting plant on a drum or sounding board. In time the soil shrinks slightly and leaves the raft at any rate partially supported by the walls, with the consequence that it vibrates severely and impairs the stability of the building. The trouble gets worse as time goes on, because the vibration of the raft pounds down the underlying soil and allows the amplitude to become greater. Such a case is a very difficult one to remedy, and is an infraction of the elementary rule that engine or machine foundations should always be clear of all walls.

The materials used almost exclusively in methods of isolation of the modern class are rubber, a special hair felt, cork in different forms, or combinations of these, and they are applied in different ways in various systems. In the Prache system, which is well known, a number of rubber stools are placed between the main foundation and an auxiliary block of concrete which carries the machine. These stools are each held in a special form of jack, which,

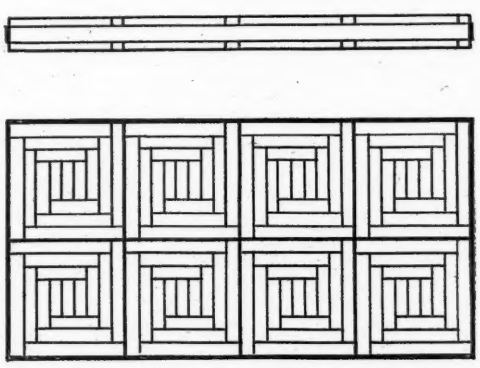


Fig. 2.—Built-up Cork Isolating Plate.

when operated, compresses the stool sufficiently to allow it to be withdrawn when renewal becomes necessary. To this end the foundation is surrounded with a trench in order to give access to the stools. There are numerous instances of the use of the system in this country, where it has been successfully employed in connection with turbo-generators, large printing presses and other heavy machines.

A further instance of the use of rubber comes from Germany, but this time it is employed in the form of thin sheets of rubber composition of $\frac{1}{8}$-in. thickness and upwards, according to the weight of the machine. A sheet of the above thickness is stated to be suited for weights up to 3 tons. An essential point of this system is that the sheet should make perfect contact with the surfaces between which it is placed, in order to exclude all air, and to this end it is necessary that the surfaces should be very smooth. By this means it is stated that holding-down bolts may be dispensed with, but the system is only advised by the makers for comparatively heavy machinery and where the centre of gravity is low.

The efficiency of cork as an isolator depends upon the manner in which it is applied. In practice it is made up into plates, which may either be composed of granulated scrap cork held together by some binding substance and subjected to pressure, or the same material relying for cohesion of the particles upon compression only and having no binding substance, or strips of virgin cork built up into a plate and held together by a suitable frame, as shown in fig. 2. The first of these is undesirable, because it is found that the binder fills up the pores of the cork and materially

reduces its resiliency. The second is better in this respect, but under the heavy pressure and vibration to which it is subjected there is a natural tendency to disintegration. The third system is undoubtedly the best, and in practice the plates are specially built up to fit the particular foundation, and are surface hardened where the weight to be carried is considerable. They are also waterproofed and otherwise treated, in order that they may be able to resist the unfavourable conditions which usually obtain. If such plates are used directly under machines, which owing to their construction do not distribute the weight evenly over the whole area, it is essential that strong planks or plates should be placed between the two, as this will secure an even bearing on the surface. The following average results of a test made upon a cork plate of this type are of interest, as they indicate what may be expected from cork in the matter of resiliency :—

Original thickness under zero load	0·72 in.
Thickness under load of 350 lb. per sq. in. ...	0·50 „
„ immediately after removal of above load	0·626 „
„ 30 minutes after removal of above load	0·675 „
„ under load of 2,500 lb. per sq. in. ...	0·394 „
„ immediately after removal of above load	0·580 „
„ 30 minutes after removal of above load	0·608 „

The principle of the system employed by the British Anti-Vibration and Noise Co., Ltd., of Glasgow, is illustrated in fig. 3. It is a departure from the usual practice

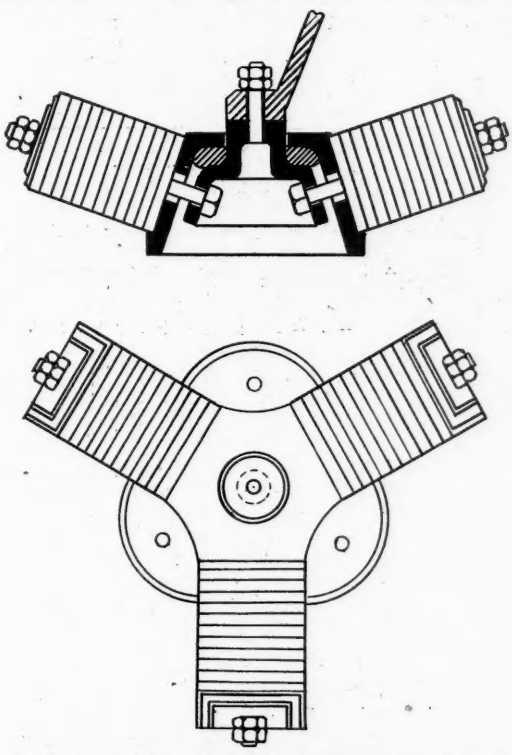


Fig. 3.—Isolating Device employing Buffers of Resilient Material.

of employing a sheet of resilient material, as under this system the machine is supported at suitable points on a number of isolators, the type varying with the conditions. In the case of the device illustrated, the internal floating part of the isolator is rigidly connected to the bedplate by a stud. Three tension members support the floating portion, and the tension in these can be regulated by nuts, in such a manner that the weight of the machine is exactly compensated for. The stresses in the three tension members are transferred by means of the plates under the nuts to the buffers, which consist of a number of elastic plates built up in layers, and from these they pass to the rigid base which is fixed to the foundation by bolts. Between the floating and fixed parts it will be noticed that an additional buffer is placed, and the function of this is to absorb that portion of the vibration which tends to raise the machine above its position of equilibrium. It is claimed for these devices that they do not in any way affect the stability of the machine when once properly adjusted, and it is clear that they will absorb both vertical and horizontal vibrations, and also any combination of the two, that is to say, eliptical vibrations. By varying the design of the isolator it is possible to apply this device to practically any machine.

A very comprehensive and valuable system of dealing with vibration troubles is that devised by Messrs. Mitchells, Ashworth, Stansfield & Co., Ltd., of London. The specially manufactured material supplied by that firm goes under the generic name of "Mascolite," and for purposes of isolation three grades are made. The first consists of a special proofed felt, which is supplied in thicknesses ranging from $\frac{1}{8}$ in. to 1 in. It is made of selected fibres of animal origin, and it is so treated that it will withstand damp, climatic changes, and the attacks of insects. The fibres

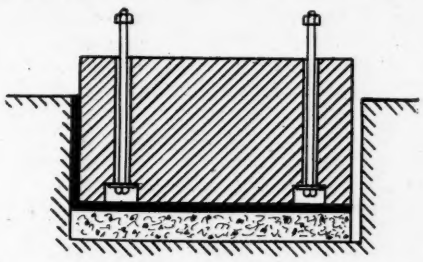


Fig. 4.—Isolated Foundation arranged for Belt Drive.

are compressed and milled by special processes and machinery, so as to make a compact material by aid of the interlocking action of the fibres themselves. Each fibre is a microscopic capillary tube, the hollow centre containing a minute air space, and by means of a special proofing solution these are sealed and made dead air spaces. This type of felt is suitable for small foundations, or to meet cases where the vibration is not very severe, but for heavy machinery, or where disturbance is very marked, it is better to employ one or other of the remaining two grades. Of these, one is built up of alternate layers of felt and cork, ranging in thickness from $\frac{1}{4}$ in. to $1\frac{1}{4}$ in., or thicker if required, and the other is similar, but with the addition of a layer of vulcanized rubber. Alternatively, the felt and rubber combination can be supplied without the thin layer of cork. The pads are about 1 in. thick with a $\frac{5}{32}$ in. layer of rubber, but they are made to any specification and to cope with conditions out of the normal. Such isolators can be applied in one of two ways ; they can be placed under the main foundation on a light concrete bed as in fig. 4, or they can go directly under the bed-plate on the top of the foundation, fig. 5. In the latter case it is essential that the holes through the bed-plate should be bushed with $\frac{1}{8}$ in. felt, and a washer of the same substance, but $\frac{1}{4}$ in. thick, placed under the bolt washer as shown, otherwise vibration will be conducted to the foundation down the bolts. These built up isolators are constructed on the principle that sound and vibration will pass more easily through a material of one density than they will through one of varying density.

Mention has been made of the manner in which buildings, particularly those of the steel-frame class, conduct vibration and noise. To follow the matter clearly, it is necessary to

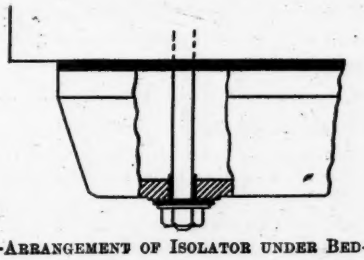


Fig. 5.—Arrangement of Isolator under Bed-plate.

understand that the disturbances set up by a machine or engine operating in such a building are primarily divisible into two classes, firstly, those which are communicated direct to the air and termed primary air vibrations, and secondly,

those which emanate from the foundation and are communicated to the floors and walls. Primary air vibrations are sensible only in the room in which they are generated, unless there are openings into other rooms, as generally they are not sufficiently powerful to cause intervening walls and floors to vibrate. Foundation vibrations, on the other hand, travel very easily through the structure in all directions, and while not always perceptible themselves, they set up what are termed secondary air vibrations, and as the frequency and tone of these are the same as those of the primary air vibrations, they are very often confused with them. It will be seen, therefore, that every effort must be made to restrict the travel of vibrations emanating from the foundation, and in the case of a building this is most effectively done by isolating the foundation, and also all beams and columns in its vicinity. Where a machine is fixed to a hollow floor it may be isolated either by a pad directly under the base-plate, or by a similar pad placed between the floor and a secondary foundation of a few inches of concrete, but in either case it is necessary to use both isolating washers and bushings, as previously mentioned, so as to prevent the transmission of vibration to the floor through the holding down bolts. The isolation of columns and joists is performed in a very simple manner by placing suitable pads between them when erecting. Sheet lead and similar materials have been used, but in efficiency they cannot compare with a good felt cushion, which is found to be lasting, and not liable to be squeezed out. In view of the great pressures to which pads so placed are subjected, this latter is an important point.

ENERGY CONSUMPTION IN CONDENSER AUXILIARIES.

THE present extensive employment of large condensing turbo-generators and the pressing need for economy in every stage of power development make it particularly important to ascertain and reduce to a minimum the energy consumption of condenser auxiliaries. According to modern standards, it is a comparatively small station which does not expend several hundred horse-power in condenser circulating water and air pumps (see fig. 1), and, as the steam consumption of these auxiliaries may easily amount to 5 or 10 per cent. of the total, even a trivial percentage economy represents a considerable annual saving, and is well worth securing. Where a complete installation of electric meters, steam and water-measuring instruments is provided, as is the case in many modern central stations, it is easy to keep a record of the energy consumption in auxiliaries from the daily log sheets, but there are other cases in which the methods described below, and based on an article by Klingenberg in the *E.T.Z.*, are applicable with advantage to the ordinary load curve which may alone be available in less elaborately-equipped stations. The methods are even more useful in connection with estimates relating to new works. There is then available an estimated load curve, and valuable assistance is obtained in selecting the best capacity for machine units.

An important advantage of the method is that it takes close account of the conditions of practice by introducing into its basic formulæ two factors—the utilisation factor and the working time factor—which eliminate much of the error due to arbitrary deductions from, or additions to, results derived from full load steam consumption data. The various curves and constants given below are based on average performance of modern turbo-plant, and do not represent "record" results achieved under exceptional conditions. Throughout, distinction must be made between those cases where condensing water is used once, and only once, and those where it is employed again and again after passing through a cooling tower or pond in the circulating circuit. Typical of the two cases are those stations using river water and those using coolers, of whatever type.

Assuming the steam consumption per hour of a given turbine to vary in direct proportion to its output, the total consumption is $(a + b)$ kg. per KW. where a = A/W = light load steam consumption per KW. of full-load rating W of the turbine; and b = B/W = additional steam consumption per useful KW. output. If h_1, h_2, h_3 = working hours per annum of the various machines; and n = mean annual useful power/total power installed = "utilisation factor"; then the main turbine steam consumption p kg. per KW.-hour is given by—

$$8{,}760\, n \times \Sigma(\mathrm{W}) \times p = \Sigma(h \,.\, \mathrm{W}).a + 8{,}760\, n.b.\Sigma(\mathrm{W}) \quad \ldots \quad (1)$$

the values of n and h being derived from actual or estimated load curves.

This equation may be simplified by introducing a "working time factor" $f = \Sigma(h \,.\, \mathrm{W})/\Sigma(\mathrm{W})$, and, if the installation consists of N machine sets of equal capacity and equal specific steam consumption, $f = \Sigma(h)/8{,}760\,\mathrm{N}$ = total working hours of all machine /maximum possible working time. Then: $p = (f \,.\, a/n + b)$ kg. per KW.-hour.

The steam consumption of auxiliaries may be taken as practically constant at all outputs of the main turbine, the exhaust from steam-driven auxiliaries being usually admitted to the L P. stage of the main turbine at all loads above 10 per cent. full load. Denoting by Q the hourly steam consumption of the auxiliaries,

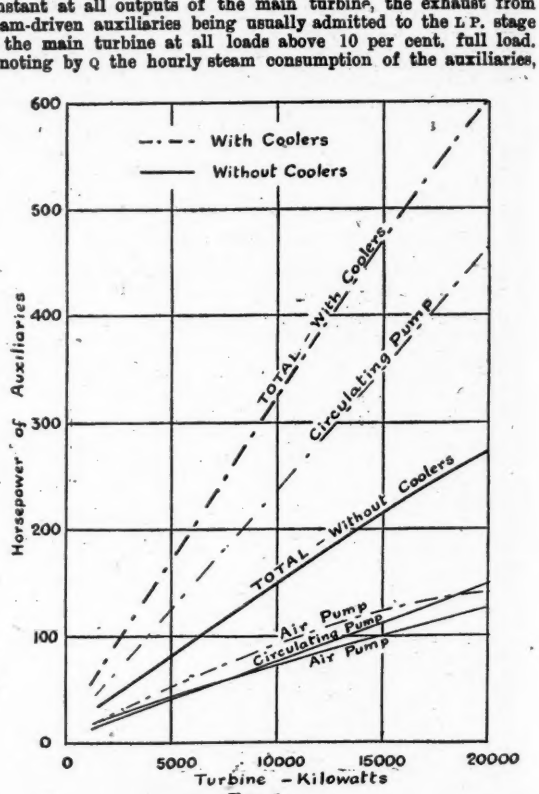


FIG. 1.

this corresponds to q = Q/W kg. per hour per KW. full load rating of the main set. The auxiliary steam consumption per KW.-hour useful output = $\Sigma(h \,.\, \mathrm{Q})/\Sigma(\mathrm{W})\, 8{,}760\, n$, and, if all machines be of equal size = $q \,.\, f/n$ kg. per KW.-hour.

Expressed as a percentage of the total steam consumption, that of the auxiliaries = $r = 100\,\mathrm{Q} \,.\, f/(\mathrm{A}f + \mathrm{B}n)$ per cent. If all

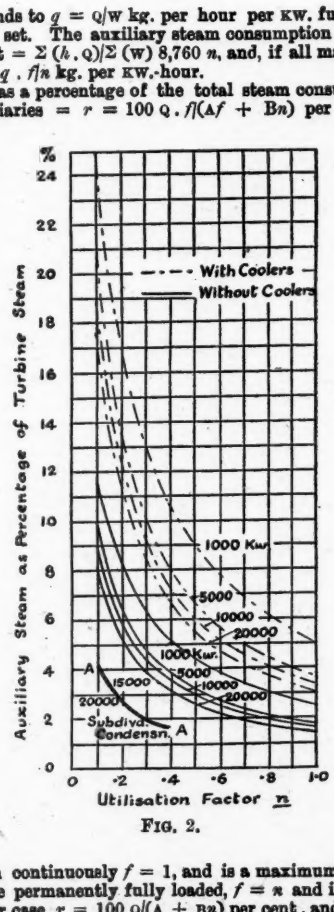


FIG. 2.

machines run continuously $f = 1$, and is a maximum whilst, if all machines are permanently fully loaded, $f = n$ and is a minimum. In the former case, $r = 100\,\mathrm{Q}/(\mathrm{A} + \mathrm{B}n)$ per cent, and is dependent on the utilisation factor, whereas in the latter case, $r = 100\,\mathrm{Q}/(\mathrm{A} + \mathrm{B})$ per cent., *i.e.*, is constant, and has its most favourable value.

Average values of the factors Q A and B are given in Table I for turbine units of various capacities. If the auxiliary steam is to be expressed as a percentage of the main turbine, (and *not* the gross) steam consumption; the values to be taken for A are 0·83 and 0·71 times, those given for fresh water and cooled water working respectively. Average values of the power consumption of condensate and air pumps and of circulating pumps for turbines of various rated capacities are shown graphically in fig. 1. The curves in fig. 2 show the very considerable importance of steam consumption in auxiliaries, particularly in the case of small works using coolers and operating with a utilisation factor of 0·4 or less; in preparing these curves it has been assumed that $f = 1$, *i.e.*, that the turbines run continuously and under variable load. The curves at A show the considerable steam economy possible by operating only half of a divided condensing equipment in the case of large sets on light load.

Only in rare cases do the curves in fig. 2 apply directly to practical conditions. Generally the working time factor lies between the limits 1 and n, hence the actual percentage r lies between the values represented by the curves in fig. 2, and those represented by lines parallel to the axis of abscisse through the lowest points of the curves (for which $n = 1·0$). The actual steam curve is derived by applying the above method to the recorded or estimated load curve of the station. Knowing the actual or proposed rating of each generating set the working hours per annum can be estimated for each, and so the working time factor evaluated for the whole installation. From the mean annual load curve there is derived a curve showing for how many hours per annum each load endures (and hence the hours' use of each machine per annum and the "working time factor" of the works). Thence follows a stepped curve showing steam consumption, according to the number of sets in use and the specific steam consumption of each; and finally a curve, the area beneath which represents

TABLE I.—Factors Determining Percentage Steam Consumption of Auxiliaries.

Full load turbine KW.	Without coolers. Q	A	B	With coolers. Q	A	B
1,000 ...	150	900	5,300	335	1,150	5,700
5,000 ...	470	2,700	25,500	1,085	3,500	27,500
10,000 ...	850	5,400	50,000	1,950	6,900	54,500
15,000 ...	1,170	7,700	74,500	2,750	9,800	81,000
20,000 ...	1,500	9,500	100,000	3,500	12,000	109,000

Q = Total auxiliary steam consumption (kg. per hour).
A = Light load steam consumption of main turbine per hour.
B = Additional steam consumption in main turbine per hour for useful output.

total annual steam consumption. The latter area divided by the area beneath the "hours of each load per annum" curve, gives the steam consumption per useful KW.-hour; and the sum of the working hours for each machine times the auxiliary steam consumption divided by the annual total steam consumption gives the percentage r of auxiliary steam consumption. This method is applicable to an installation of machines of any sizes and any specific steam consumptions. The purely numerical method is simpler where, as is often the case, a number of similar sets of equal capacity are installed.

Using one, two, three or five, 20,000-KW. sets (plus one set in reserve in each case) to supply peak loads of 12,500, 25,000, 50,000 and 100,000 KW. respectively, the mean loads being 40 per cent. as great (*i.e.*, load factor = 40 per cent.):—The working time and utilisation factors, the total and auxiliary steam consumptions are then as below:—

No of 20,000-KW. sets installed (one in reserve)	2	3	4	6
Peak load in KW. ...	12,500	25,000	50,000	100,000
Working time factor (f)	50 %	36·7 %	42·1 %	43·8 %
Utilisation factor (n) ...	12·5 %	16·6 %	24·9 %	33·2 %
Total steam per KW.-hour (annual mean)	*Without coolers.*			*With coolers.*			
in lb. ...	15·2	13·3	12·8	12·4	17·4	15·0	14·3	13·8
Relative ditto, per cent. ...	122·6	107·5	103·2	100	126·2	108·6	103·5	100
Auxiliary steam as percentage of total steam, per cent. ...	4·35	2·74	2·19	1·76	8·95	5·71	4·59	3·71

Naturally, one would not install two 20,000-KW. sets to supply a peak load of 12,500 KW. unless considerable extensions were certain in the near future, but the case is included as an extreme example. Since specific steam consumption changes little within wide limits of load it is desirable to install large sets, in the interests of ultimate capital economy in cases where extensions would otherwise be needed at an early date.

In the case of a smaller station, where three 1,000-KW. sets (one in reserve) are installed to supply mean and peak loads of 540 and 1,800 KW. respectively, the working time factor is 43 per cent., the utilisation factor 18 per cent., and the total steam consumption 16·3 lb. without and 18·6 lb. with coolers. The auxiliary steam consumption is approximately 4·8 per cent. and 9·5 per cent. in the two cases respectively, so that from these figures and those in the preceding summary it follows that under average conditions in power stations from 1,000 to 100,000 KW. rating, the steam consumption of auxiliaries ranges from 1·8 to 5 per cent. using river water and from 3·7 to 10 per cent. using coolers. This item in the power balance-sheet is particularly important in the case of small stations employing water coolers and operating with a poor utilisation factor (= mean useful/installed power). This fact should be borne well in mind by station engineers operating or contemplating the adoption of relatively small turbo units in provincial towns.

IGNITION MAGNETOS.

In *La Revue Electrique* of April 16th (published in June), M. H. Armagnat discussed at some length the principles and practice of magneto-electric machines used for ignition, &c., and as the subject is one about which little is known, though it is of considerable importance, we give below an abstract of the article.

As in this country, so also in France the Germans had secured the great bulk of the trade in magnetos, not by their own discoveries so much as by the thorough exploitation of foreign inventions; they made progress only by trial and error, and often put on the market so-called inventions which turned out to be huge mistakes. A careful study of the subject leads the author to the conclusion that the German control of the market was due, not to technical inferiority on the part of the French manufacturers, but to the lack of commercial organisation on their part, which can be quickly remedied.

After a brief historical sketch, in which he shows that the elements of both high and low-pressure sparking plugs, used in conjunction with induction coils and magnetos, were embodied in the patents of Lenoir (1860), Marcus (1883), and other pioneers before the internal-combustion automobile entered the field, the author describes the Simms-Bosch type of magneto with stationary armature, which was quickly followed by the Boudeville double-wound armature, a French invention; the condenser was added in 1902, when the first successful high-pressure magneto was introduced, and this type has now almost eliminated the low-pressure system of ignition—at any rate, in the case of the automobile.

There are two main types of magneto: that which acts at low pressure, by interruption of the circuit, and the high-pressure type. In the former case the current generated by the magneto is broken inside the cylinder of the engine by the mechanical separation of two metal parts, the "extra-current" spark which is then produced igniting the gaseous mixture. In the latter case, the current generated by the magneto is interrupted at the proper time

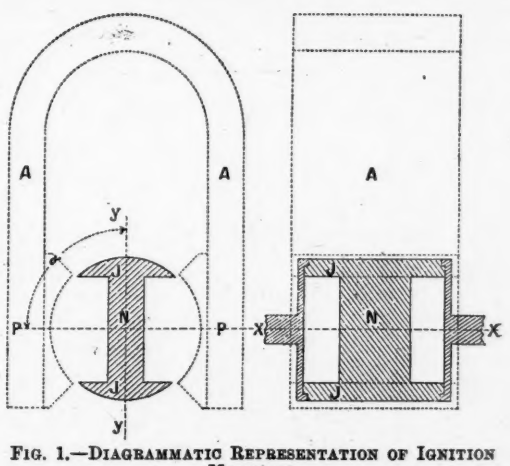


Fig. 1.—Diagrammatic Representation of Ignition Magneto.

by a device attached to the machine, and a high electromotive force is induced thereby in a fine-wire coil wound over the first—in fact, the armature becomes a rotating induction coil, in which the primary current results from the rotation instead of being derived from an external source. A compromise between the two systems employs a stationary induction coil between the magneto and the sparking plug. In all cases the most important function of the magneto is to generate the current.

The machine consists essentially of a rotor in the form of a shuttle, upon which are wound the primary and secondary coils, and a stator consisting of a row of horseshoe magnets with iron pole-pieces (fig. 1). The old Siemens "H" armature has been found superior to all other types for the purpose in view; it consists of a soft iron core N, with two pole shoes J, carried on spindles X X between the poles P of the permanent magnets A. The wires are wound on the core N and connected to insulated rings, which enable the current to be led away by rubbing collectors to the external circuit. Owing to the complex relationship between the flux through the core N and the angle α between the axis of the core $y\,y$, and that of the poles P P, the current generated cannot be calculated without determining this relationship by experiment; when this curve is obtained, the characteristics of the magneto can be determined.

Three methods are available for this purpose: (1) variation of flux; (2) rotating contact; and (3) the oscillograph.

In (1) the coil is connected to a ballistic galvanometer, and is sharply rotated through a small but constant angle, not exceeding 10°, always in the same direction, the corresponding deflections of the galvanometer being noted. A simple device for carrying out this operation is shown in fig. 2; it consists of two levers A and A′, fixed on the spindle C of the magneto by thumb-screws B B′, and capable of oscillating between the stops V_1 and V_2. The direction of rotation being that shown by the arrow, the two levers are first brought into contact with V_2, and screwed tight when the armature is in a known position. The levers are then sharply thrown over to the stop V_1, rotating the armature through the angle α, and the deflection of the galvanometer needle is observed. Next B is slackened, and the lever A is brought into contact with V_2, while A′ is kept hard up against V_1; afterwards B′ is slackened whilst A is kept against V_2 and A′ is brought back to V_2 and secured by B′. The cycle of operations is then repeated. The successive deflections obtained are proportional to the change while $B_n - B_{n-1}$ is the change of induction, $\theta_n = K (B_n - B_{n-1})$, of flux at each step, and if θ_n is the deflection for an angle α, where K is a constant; if α has been made very small, we can write—

$$\theta/\Delta\alpha = K (B_n - B_{n-1})/\Delta\alpha = K \cdot \Delta B/\Delta\alpha.$$

Plotting the angles as abscissæ and the values of the deflections as ordinates, adding the successive values in each case, so that—

$$\Sigma\theta = K \Sigma_1^n (B_n - B_{n-1}) = K (B_n - B_o),$$

we obtain the curve of induction as a function of the position of the armature between the poles, or $B = f(\alpha)$, whilst if for the ordinates we plot only the successive values of θ for small and equal increments of α, we have $\Delta B/\Delta\alpha = \phi(\alpha)$; the second curve is, to a first approximation, the derivative of the first curve, and if the increments of angle are not greater than 4° to 5°, the accuracy is sufficient for practical purposes. Fig. 3 is an example of the curves thus obtained.

Method (2) is the well-known Joubert contact method, in which a contact is made once in each revolution with a circuit containing a condenser and galvanometer, by which the instantaneous

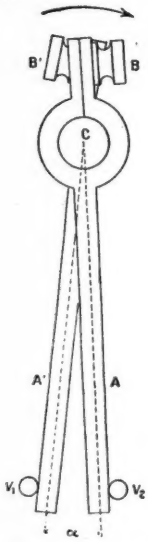


FIG. 2.—ARRANGEMENT FOR EFFECTING SUCCESSIVE SMALL ROTATIONS.

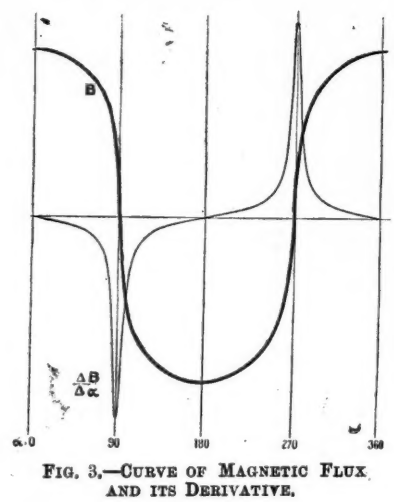


FIG. 3.—CURVE OF MAGNETIC FLUX AND ITS DERIVATIVE.

E.M.F. of the magneto armature is recorded when driven at constant speed, and by varying the position of the contact with regard to the coil a curve proportional to the strength of field at each point can be obtained. Lastly, the oscillograph gives by direct reading, with a high resistance in circuit, a curve similar to that last mentioned, or, if the oscillograph is shunted, the current curve can be obtained under practical conditions.

These three methods have their advantages and drawbacks. The point method gives an exact curve of flux, and the derived curve $\Delta B/\Delta\alpha$ is very nearly that of $dB/d\alpha$; with these two curves the current wave form can be predetermined, but no information is given as to the phenomena which depend upon the speed, such as those due to eddy currents and hysteresis. For this reason the oscillograph method is the best, but requires expensive apparatus, and the results obtained must be subjected to painstaking scrutiny in order to eliminate several causes of error.

Fig. 4 shows an oscillograph curve, which it will be seen differs considerably from the curve $\Delta B/\Delta\alpha$ in fig. 3; whilst the latter is practically symmetrical about the maximum, the corresponding oscillogram shows a strong distortion. This is due to the fact that, as in the Joubert method, the current generated by the coil in energising the measuring apparatus is far from negligible.

This distortion of the curves has sometimes been attributed to hysteresis, but is only due to the current, for hysteresis is present to the same extent in the method by points, though, in the latter case, it is always masked by the errors of measurement.

Starting with a curve of flux that has been carefully determined, the instantaneous values of the current strength can be calculated by a method of approximation, based upon the formula:—

$$i = \frac{n S}{L} (B - B_c) - \frac{R}{2\pi m L} \int i \, d\alpha$$

where i is the current at any moment,
S the cross-section of the iron core N,
n the number of turns of the winding,
B the magnetic induction in the core,
L the inductance of the circuit (assumed constant),

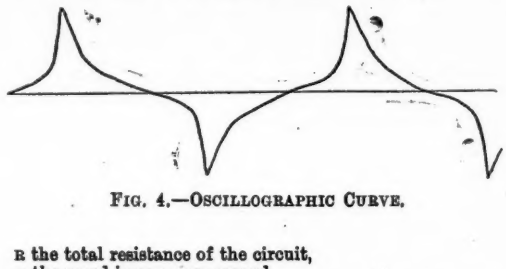


FIG. 4.—OSCILLOGRAPHIC CURVE.

R the total resistance of the circuit,
m the speed in revs. per second,
α the angle between the axes of the core and of the pole-pieces.

Dividing the abscissæ into equal intervals as in fig. 5, each representing a very small angle β, and taking as origin the moment of closing the circuit, if we assume that the current strength varies linearly between these divisions, the successive ordinates have for values:—

$$i_o = 0,$$
$$i_1 = a (B_1 - B_o),$$
$$i_2 = a (B_2 - B_o) - b\, i_1,$$
$$i_n = a (B_n - B_o) - b \Sigma_1^{n-1} i,$$
where $a = 4\pi m n S/(4\pi m L + \beta R)$
$b = 2\beta R/(4\pi m L + \beta R)$.

Experiment shows that the curves calculated in this way agree exactly with the curves obtained with the oscillograph, when the necessary precautions are taken; as mentioned above, owing to the small power of the magneto, it is difficult to intercalate the oscillograph in the circuit without upsetting the conditions materially, and hence it is often preferable to plot the curve of flux by points.

Fig. 3 shows that the flux curve and its derivative are far from sinusoidal; this, which would be a drawback in most electrical applications, is a considerable advantage in the case of ignition magnetos. The problem is very different from those ordinarily met with in electrotechnics; automobile explosion engines have a very wide range of speed, and the magneto must supply the ignition current under all circumstances at the right moment, even during the operation of starting the engine by hand. These extreme conditions require that the current furnished by the ignition magneto shall be strong enough at starting, and at a speed of 40 R.P.M., and yet shall not be excessively strong at a

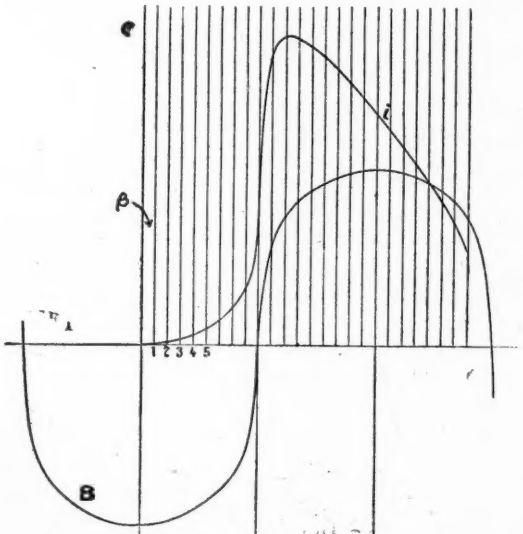


FIG. 5.

speed of more than 2,000 R.P.M.; so that the ratio of the limiting speeds in normal operation is of the order of 50. At very low speeds the strength of the current is approximately $i_o = 2\pi m_o n S/R \cdot dB/d\alpha$; on the other hand, at very high speeds we may say that $i_m = n S (B - B_c)/L$, where B_c is the value of the induction at the moment of closing the circuit and B the value at the instant considered. The object being to

obtain a current i_o which shall be adequate for ignition at a very low speed m_o, and a current i_m at the maximum speed which shall not be excessive, we get from the ratio of the foregoing expressions: $\frac{i_o}{i_m} = \frac{2\pi m_o L}{R} \cdot \frac{d B_r / d\alpha}{B_r - B_c}$, from which we see that the greater the ratio $d B_r / d\alpha : (B_r - B_c)$, the less may be the lower speed m_o, B_r being the induction at the moment of rupture of the circuit, and B_c that at the moment of closing the circuit. Taking the ratio between the maximum value of $d B/d\alpha$ and $B_{max.}$, there results a characteristic coefficient $z = (max.\ d B/d\alpha)/B_{max}$ to which we shall return later.

But it is not sufficient that the maximum current should reach a definite value; it is also necessary that this value should be obtained at an almost constant position of the rotating coil with regard to the pole-pieces, so as to obviate the need of adjusting the point of rupture for each speed. If we could neglect the resistance in circuit at high speeds, the maximum current i_o reached at the moment of great variation of flux would lead by 90° upon the

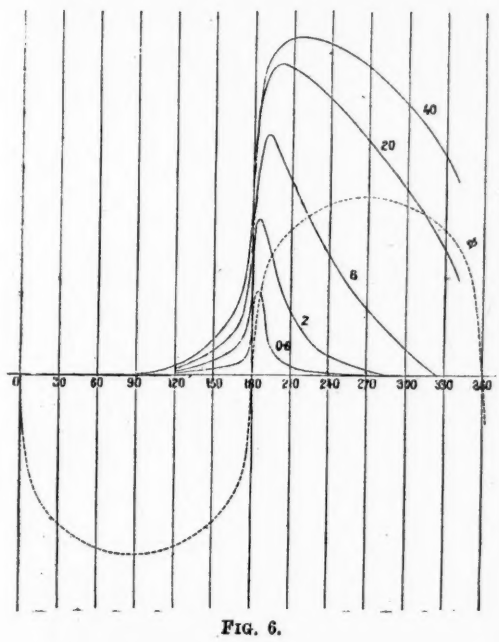


Fig. 6.

maximum current i_m at high speed, represented by the summit of the curve of flux ϕ, and between these limits the spark would have to be continually advanced or retarded in order to secure good ignition by breaking the current at the right moment. Fortunately the limiting case indicated by the equation for i_m above is not reached in practice; thanks to the resistance R of the coil, the maximum intensity of the current is always attained near the point of reversal of the flux.

Fig. 6 shows the curves of current calculated for an average magneto, for which the flux curve has been experimentally determined. The intensities have been calculated for speeds from 0·6 to 40 revs. per second, for the coil on short circuit, that is, under normal conditions of operation before the spark, the circuit being closed at the moment of maximum flux. It will be seen that, while the speeds vary in the ratio 1 : 66, the maximum current increases only from 3·2 to 13 amperes, or in the ratio of 1 to 4. The coil used for this example had a resistance of 0·57 ohm and an average inductance of 0·012 henry; B_m was 13,700; $s = 4{\cdot}75$ cm.^{2}, and $n = 159$ turns.

In order to obtain, with sinusoidal current, the same current strength at low speed, the magneto would have to be five times as powerful as it is with the Siemens H armature.

(*To be concluded.*)

The Electric Vehicle Committee.—At the last meeting of the Committee, held on October 1st, Mr. V. Mason took his seat as the representative of the Light Railways and Tramways Association. The Committee had submitted for its inspection, by the Krieger Electric Carriage Syndicate, Ltd., the first of the new "Ward" light delivery vans to arrive in this country from America. It was reported that the sales of No. 4 issue of the *Electric Vehicle* had been very satisfactory; it was decided that no further publicity work could be done at the present time other than to concentrate upon keeping the official organ going successfully. The further standardisation of details in connection with lead-plate batteries was discussed, and the Committee will now await the decision of the Accumulator Makers' Section of the B.E.A.M.A. upon its proposals.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Institution and Alien Enemy Members.

As the Institution of Electrical Engineers will shortly be resuming its meetings, I am writing to ask for the support of your paper to endeavour to get a statement from the President on behalf of the Council that it will follow the lead of the Iron and Steel Institute, to the effect that during the state of war between Great Britain and other countries, all Members Honorary Members, and Honorary Vice-Presidents, also Associates and others, who shall be subjects of such countries or States, shall forthwith cease to be members (and this also to apply to those of enemy origin, whether naturalised or not), as it is extremely undesirable that they should have the facility of attending the meetings of the Institution; also, that they shall be subject to re-election by the Institution as a body at the termination of the war, provided there can be found members sufficiently forgiving and willing to believe in the honour of these individuals to propose and second them.

As the Council of the Institution probably acts like the Cabinet of the Government, and does not read the papers, or pleads ignorance as to their contents, I trust that all Members, Associate Members, and others who pay subscriptions to the Institution will, if they are in accord with this suggestion (and I hope, as true Britishers, they will be), write to the secretary, informing him that they wish such statement to be made by the Council at the first meeting which is held.

It is useless to say that the Institution, as a scientfic body, cannot enter into national politics, when one views the base and inhuman ways in which the scientific world of Germany has assisted in the warfare which has been carried on by that nation, and it is quite within the bounds of possibility that such "honourable" methods of warfare as liquid fire and poisonous gas may have been introduced by some of our alien members.

The time has come, in my opinion (and, I trust, in that of your readers also), when we should keep all such Institutions exclusively for British-born subjects or members of our Allies only. I can quite understand that it might mean a somewhat hard parting with certain respected members of the Institution, but let those who have lost their dearest ones on the battlefield, and those who have them still there fighting for the defence of their home and country, remember that under no circumstances can a leopard change his spots.

Station Engineer.

[With the spirit of our correspondent's letter we cordially agree. The suggestion in the last paragraph, however, would raise difficulties in connection with neutrals, and might injure ourselves more than our enemies.—Eds. Elec. Rev.]

The A.E.G. Meeting.

Some of our friends are becoming alive to a very sinister feature in the electrical trade, in the form of the maintenance of German electrical interests in this country, both by the keeping alive of branches—A.E.G. or Electrical Co., &c.—and the importation of manufactured goods of quite obvious German finish.

Electrical engineers of experience must have noticed that, while the stock of German goods was exhausted shortly after the war commenced, there seems quite a good supply of goods at the present time, the finish and workmanship being very distinctly German. For many years I have been convinced, as the result of wide experience, that our traders and engineers have been hypnotised by the German fetish, and that, if they had taken the trouble to carry out exhaustive tests, under similar conditions between German and British goods, the supposed German superiority would have vanished; usually the balance comes out on the British side. As a nation we are so self-depreciating that German agents have not had a very difficult job in booming the superiority of their wares.

Union Jack.

Australian Electrical Trades Union.—According to an Australian newspaper, it was reported at the annual meeting of the Electrical Trades Union of N.S. Wales that there was a membership of 1,704. Despite the war, the financial year had been the most successful in the history of the Union. The Newcastle branch was on a sound footing, and had a membership of 90. In Sydney more than 350 positions had been filled direct from the Union office. Only financial members were recommended for vacancies. A fund for distressed members was desirable. The Union's relations with the main body of employers had been cordial throughout. Although cases had arisen in which it was found necessary to report breaches of awards, these had mostly occurred among the small irregular contractors and firms not primarily connected with the electrical industry. On the whole, trade had been unexpectedly good since August of last year. The falling-off in other directions had been largely counterbalanced by the activity of the Naval Department. A number of members had gone to the United Kingdom, where electricians were greatly in demand in connection with the work at the naval dockyards.

WAR ITEMS.

Electrical Plant Contracts during War Time.—An interesting discussion took place at a meeting of the Edinburgh Town Council regarding the contracts for the new electric power station at Portobello. The Electric Lighting Committee recommended the Council to accept (1) the estimate of Messrs. Fraser & Chalmers, Erith, for turbines and alternators (with Messrs. Vickers as the makers of the alternators), amount, £23,251; and (2) the estimate of Messrs. Fraser & Chalmers for condensing plant (with Messrs. Richardsons, Westgarth & Co., Hartlepool, as sub-contractors), amount, £7,611; delivery in the case of both contracts to be made in the summer of 1917. Supporting the recommendation, the Convener (Mr. Stevenson) said that in the opinion of experts steel would be much dearer after the war than it was now. They were, therefore, saving money by placing the order now. Vickers were doing a good deal of war work, and he had written to the firm asking whether that would not delay work on the Council's order. In their reply they stated that after full consideration of their present commitments for the Government they could say confidently they could deliver the goods within eight months of instructions. In the course of the discussion which followed, it was argued that the extension at Portobello could perfectly well be deferred without doing the least harm to the city, and that there was sufficient electric current at present to provide all the lighting inside the city. It was also contended that they should not encourage firms doing Government work to take on private work. Mr. Bruce Lindsay, in a vigorous speech, pointed out that the demand for electric current was going up, and that if they did not look ahead the electric department would be in a serious position in a few years. The Convener, replying to the critics, said he wanted to get on with the building at once, because they needed it, and because it was not true to say that they had sufficient machinery in hand just now to keep pace with the demand made upon it. At present there were people asking for power who could not get it. If they were not in a position to supply power to one large firm in the town, a new factory which was being built would stand doing nothing. On a vote the Committee's recommendation was approved by 35 votes to 11.

Air Raids and Fire Extinguishers.—The Chief Commissioner of Police of the Metropolis has issued a new warning to the public in connection with hostile air raids. We are requested to draw our readers' attention to the matter, and we give the following extract from the warning:—"Many dry powder fire extinguishers are much advertised. The Commissioner warns the public, as the result of experiments made, at his instance, by a competent committee of experts, that no reliance can be placed upon such appliances for effectively controlling fires such as are likely to be caused by bombs, explosive or incendiary. The Commissioner is advised, as the result of these experiments, that the provision, and prompt and intelligent use of water, or of sand, or of both, in dealing with such outbreaks of fire is the best, simplest and most economical safeguard."

The Lighting of London.—The following is a copy of a further official order that was issued on 7th inst.:—"As the result of the new lighting order and of the arrangements discussed at a conference with the lighting authorities held at the Home Office last week, the private and shop lighting of the London area has been brought generally within the required limits, which must continue to be observed. This, however, has had the effect of materially reducing the total illumination of the streets, and since the object to be attained by the reduction of lighting is not a near approach to complete darkness, but a uniform degree of subdued illumination throughout the area, it is believed that, in the process of equalisation which is now proceeding, the public lighting of both the main and side streets may be somewhat increased. Any changes in this direction must, however, be made only on instructions given by the Commissioners of the Metropolitan and City Police on the advice of the Anti-Aircraft Department of the Admiralty, who have made, and will continue to make, observations to ascertain what degree of lighting may be permitted."

German Connections in Australia.—A Reuter dispatch from Sydney reports Mr. Hughes, the Federal Attorney-General, as stating that, when war broke out, German control of trade and industry in Australia was very widespread and was gaining rapidly. It really appeared that the public of Australia was unable to be satisfactorily supplied except through German sources. Contracts, including some for Government and municipal works, aggregating millions of pounds sterling, had been entered into.

Exports to China and Siam.—A supplementary list of firms in China and Siam, to whom articles may be exported during the war, appears in the "London Gazette" for October 8th.

Patent Restoration.—An order has been made restoring letters patent No. 17,817 of 1907 granted to Augustus C. Hyde, for "Improvements in making electrically conducting joints in metallic-filament incandescent electric lamps."

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

13,681. "Electro-magnetic couplings." H. A. Cooper. September 27th.

13,697. "Dynamo or motor." H. W. Brown & J. Dollard. September 27th.

13,727. "Electric flashlight signalling instruments." J. W. Mander. September 27th.

13,733. "Sparking plugs." V. Joly. September 27th. (Complete.)

13,750. "Method of and means or apparatus for augmenting the effect of small electric currents." W. M. Mordey. September 27th.

13,754. "Stationary electrode for igniters." The Standard Co. September 27th. (Convention date, September 26th, 1914, United States.) (Complete.)

13,762. "Electric heating, boiling, and flat-ironing apparatus." J. Kluijtmans. September 28th.

13,769. "Loading coils for telephone lines." Western Electric Co., Ltd. (Western Electric Co., U.S.A.) September 28th. (Addition to 12,434/15.) (Complete.)

13,774. "Electro-magnetic power transmission for motor-car." J. Dollard and H. W. Brown. September 28th.

13,788. "Electric generators." D. Suchostawer. September 28th.

13,801. "Electrical supply systems at constant current-strength and varying voltage." R. Thury. September 28th. (Convention date, June 16th, 1915, Switzerland.) (Complete.)

13,806. "Electric bells and the like." R. E. H. Lovelace, C. E. Ford, and Edison & Swan United Electric Light Co., Ltd. September 28th.

13,807. "Miners' electric lamps." G. A. Bellamy. September 28th.

13,837. "Regulators for X-ray bulbs and like apparatus." C. G. Roch. September 29th. (Complete.)

13,852. "Hot-wire ammeters." Marconi's Wireless Telegraph Co., Ltd., and H. A. Ewen. September 29th.

13,869. "Horary electric meters." A. Aubert. September 29th. (Convention date, October 1st, 1914, Switzerland.) (Complete.)

13,877. "Ceiling-rose connector." C. E. Garratt. September 30th.

13,879. "Electric lighting for sewing machines and other machines and the like." J. F Needham. September 30th.

13,886. "Dynamo-electric machines." F. A. Heys (Neuland Patents, Ltd., U.S.A.). September 30th. (Complete.)

13,888. "Dynamo-electric machines." F. A. Heys (Neuland Patents, Ltd., U.S.A.). September 30th. (Complete.)

13,899. "Apparatus for use in wireless telegraphy and the like." M. F. Sueter, R. M. Groves & B. Binyon. September 30th.

13,901. "Fittings for electric incandescent candle lamps." C. H. Burt and Huntalite, Ltd. September 30th.

13,902. "Thermic telephones." Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. September 30th. (Convention date, April 26th, 1915, Germany.) (Complete.)

13,904. "High-frequency dynamo-electric machines." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). September 30th.

13,912. "Electro-magnetic power transmission apparatus." A. H. Neuland. September 30th. (Complete.)

13,915. "Construction of electric head-lamp reflectors." P. E. Correll. September 30th. (Complete.)

13,934. "Operating rotary converters and other alternating-current machinery. A. H. Railing & C. C. Garrard. October 1st. (Addition to 10,841/13.)

13,943. "Method of manufacturing the caps for electric incandescent lamps." C. E. Hunter. October 1st.

13,973. "Sound detecting and measuring systems." Western Electric Co., Ltd., & G. H. Nash. October 2nd.

13,984. "Portable electric-lamp apparatus." A. B. Crawford. October 2nd.

13,985. "Starting and ignition arrangements for internal-combustion engines." British Westinghouse Electric & Manufacturing Co., Ltd. October 2nd. (Convention date, October 3rd, 1914, United States.) (Complete.)

PUBLISHED SPECIFICATIONS.

1914.

14,125. Electrical Apparatus for Transmitting and Receiving Signals. Sir A. T. Dawson & G. T. Buckham. June 11th.

17,863. Electric Contact Apparatus, particularly for Telephone Systems. F. Brinkmann. July 28th. (October 24th, 1913.)

19,492. Internal-combustion Engine with Electrically-driven Charging Pump. Allgemeine Elektricitäts Ges. September 5th. (September 6th, 1913.)

19,854. Electric Signalling Systems, particularly for use in Mines. Sterling Telephone & Electric Co., and H. W. Barclay. September 16th.

19,977. Electric Lighting and Heating of Railway or other Vehicles. C. H. Vidal. September 19th.

20,687. Means for rendering Air, Damp, and Watertight, the Junction of Electric Wires or Cables with Boxes or Casings containing Electric Apparatus or the like. A. Holmes & T. H. Brierley. October 8th.

21,529. Telephone Switching Apparatus. Western Electric Co. & R. A. Mack. October 26th.

23,212. Electrical Coupling Devices. G. St. J. Day. November 28th.

23,534. Electric Lamp-holders and Similar Couplings. A. A. Schaschke and Sharp. December 4th. (Cognate application, 3,106/15.)

24,293. Electric Starters for Engines, more particularly those for use on Motor-cars and the like. A. H. Midgley & C. A. Vandervell. December 18th.

24,766. Construction of Solid-metal Electric Vapour Lamps. H. J. S Sand. December 30th.

1915.

4,012. Mechanism for Electric Switches of the Push or Pull Type. Maricanola & Testa. March 13th. (March 14th, 1914.)

5,672. Brushes and Brush-holders for Magneto-electric Machines. C. C. W. Simpson. April 15th. (Divided application on 19,784/14, September 15th.)